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the ACCOUNTING REVIEW

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Predicting Audit Qualifications with Financial and Market Variables

Nicholas Dopuch, Robert W. Holthausen, and Richard W. Leftwich

ABSTRACT: This paper investigates the extent to which models based on financial and market variables predict auditors' decisions to issue qualified audit reports in situations involving contingencies or uncertainties. A probit model is developed with the dependent variable indicating whether the firm received a qualified opinion, and the independent variables representing publicly available financial and market variables. The estimated model distinguishes between unqualified (clean) opinions and first-time qualifications and between types of qualifications (e.g., going concern, litigation, asset realizing, and multiple qualifications) in the year of the qualification, for both an estimation sample and a holdout sample. The predictive accuracy of the estimated model is evaluated in terms of misclassification costs for alternative costs of type I and type II errors and for specific prior probabilities of qualified and clean opinions.

THIS paper provides evidence of the association between audit qualifications for contingencies and firms' financial and stock market variables. The results indicate that the model should be useful for auditors and researchers because auditors' decisions about qualifications are systematically related to financial and market variables.

Auditors can use the model as a decision aid to identify clients that are likely to receive qualified opinions or to screen potential clients. In addition, the model can serve as a benchmark to represent the probability that a "typical" auditor would issue a qualified opinion under similar circumstances. The benchmark would be useful in peer review committees, in debates about "opinion shopping," in quality control procedures within firms, and in court cases involving auditor negligence for not issuing qualified opinions.

Researchers can use the model as a proxy for investors' expectations of a qualified opinion. For example, previous research suggests that announcements of

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Nicholas Dopuch is Professor of Accounting, Washington University, Robert W. Holthausen is Associate Professor of Accounting, and Richard W. Leftwich is Professor of Accounting, University of Chicago.

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qualified opinions in the *Wall Street Journal* affect stock prices, even though announcements in annual reports or 10-K's have little effect.[1] The model can improve the power of statistical tests of stock price effects by distinguishing between opinions that are predictable with publicly available data, and those that are more likely to be "surprises." Similarly, researchers investigating auditor changes may find the model useful in identifying switches prompted by "unwarranted" qualifications.

Several researchers have investigated variables that predict auditors' uncertainty qualifications, but none has employed stock market variables. (See, for example, Bell and Tabor [1986]; Mutchler [1985]; and Wilkerson [1985].) Previous attempts to "model" auditors' qualifications focus on going concern opinions and use relatively small samples with a matched-pair design. As discussed below, the matched-pair design produces estimated probabilities that are upward-biased if the event being predicted is relatively rare. (The unconditional probability of a first-time qualification is less than five percent for the time period of this study.)

The evidence in this paper is obtained from a sample of 275 first-time subject-to qualifications and a sample of 441 unqualified (clean) opinions during the period 1969–1980. For each sample firm, the probability of a qualified opinion is estimated with a probit model incorporating variables that summarize the firm's financial and stock price performance. Each firm's opinion is then classified as either qualified or clean based on cutoff probability scores that minimize the expected cost of misclassification for alternative costs of type I and type II errors, explicitly taking into account the prior probability of observing a firm with a qualified opinion. The expected misclassification costs of the model compare favorably with the expected misclassification costs of a naive benchmark. The predictive ability of the model varies across types of uncertainty qualifications—the greatest accuracy is achieved with going concern qualifications, the least with litigation qualifications. As expected, the financial and market variables of firms receiving going concern opinions reflect severe financial distress, whereas the financial and market variables of firms receiving litigation qualifications reflect little aberrant performance.

To assess the extent of search bias and overfitting in the estimated model, the predictive ability of the model is evaluated with a holdout sample that is designed to be independent of the sample used to construct the model. The model is susceptible to overfitting because the candidate explanatory variables are not specified formally *ex ante* and several transformations of the variables are tested. One critical variable (the dollar magnitude of the contingency) is omitted because it seldom can be calculated from publicly available data. Information about the distribution of the magnitude of the contingency would improve the predictive power of the model.

The study is based on actual qualified and unqualified (clean) opinions and does not investigate whether those opinions are optimal for particular tradeoffs facing auditors. The literature contains little evidence about how auditors determine whether to issue a qualified opinion for a contingency. The qualification decision involves economic tradeoffs because auditors who qualify too frequently risk losing clients and those who seldom qualify are exposed to lawsuits and loss of reputation.[2] The research design in this paper does not allow investigation of these tradeoffs.[3]

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[1] See, for example: Ball, Walker, and Whittred [1979]; Elliott [1982]; Dodd et al. [1984]; and Dopuch, Holthausen, and Leftwich [1986].

The samples and data sources are discussed in Section I of this paper. Section II describes the financial and stock market variables included in the probit model. Section III contains the estimated probit model, together with the predictive ability tests. Brief conclusions are presented in Section IV. The Appendix explains the estimation procedures for the unconditional probability of a first-time qualification in the population, and explores the sensitivity of the probit results to alternative estimates of that probability.

I. SAMPLE SELECTION

The study uses a choice-based (or state-based) procedure to sample observations of first-time qualifications and clean opinions; that is, first-time qualified opinions are oversampled relative to their true proportion in the population. Choice-based sampling reduces data collection costs because qualifications occur infrequently in the population and a random sample would produce relatively imprecise parameter estimates unless extremely large samples were used. The sample of firms with first-time audit qualifications resulted from the following procedures:

1. Select all New York and American Stock Exchange (NYSE and AMEX) firms with "subject to" qualified opinions and disclaimers of opinions reported in either the *Disclosure Index* from May 1973 to April 1976, or on the National Automated Accounting Research System (NAARS) from 1976 to 1980.
2. Examine the 10-K for the appropriate year to confirm that the auditor's opinion was qualified.
3. Determine whether the previous year's opinion was qualified by examining the relevant 10-K, and continue searching prior years until an unqualified (clean) opinion is formed, but do not search prior to 1969.

The third step ensures that the sample of firms with qualified opinions has first-time qualifications because the audit opinion changed from unqualified to qualified since the previous fiscal year.

A sample of firms with clean opinions was selected to match the time profile of the qualified sample as a control for general macroeconomic factors that affect the financial prospects of all firms.[4] The time-matched sample of firms with clean opinions resulted from the following procedures:

1. Randomly select firms from the University of Chicago 10-K microfiche file for each of the years 1969–1980.
2. Exclude firms that were not listed on the NYSE or AMEX during the selected fiscal year.
3. Exclude firms that received "subject to" uncertainty qualifications, but include firms with consistency exceptions in their opinions.
4. Continue the process for a particular year until the number of sample observations with clean opinions in

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[2] For a statement of professional standards concerning qualified opinions, see American Institute of Certified Public Accountants [1986, especially Au 509 and Au 9509.11–.14].

[3] See Wilkerson [1985] for a research design that allows such questions to be addressed.

[4] The numbers of firms in each year are not identical for each sample because data availability conditions exclude more observations from the qualified sample than from the clean sample. The effects of data availability constraints on the estimated model are discussed by Heckman [1979], Poirier [1980], and Maddala [1983]. Zmijewski [1984] demonstrates the effect for financial distress prediction models.

that year is equal to the number of firms in the qualified sample in that year.

Minimum data requirements are imposed on both the qualified and clean samples. Firms are retained in the sample if there are sufficient CRSP and COMPUSTAT data to compute all nine of the financial and stock market variables discussed below. Firms are excluded if they changed the end of their fiscal year for the sample year or the previous year, or if they are in the financial service industry (SIC codes 6000-6999).[5]

The qualified and clean samples are each split into an estimation sample and a holdout sample. A time-series holdout sample is selected instead of a cross-sectional holdout sample for three reasons. First, the incidence of audit qualifications varies across industries at a point in time, and financial and market variables can proxy for industry membership. Those variables can be spuriously correlated with auditors' decisions in a cross-sectional holdout sample, but not in a time-series holdout sample that is independent of the estimation sample.[6] Second, a time-series holdout is relevant if auditors want to know whether models estimated on historical data can be used to make predictions. Third, since the holdout comes from a different time period, differences in the costs and benefits facing auditors in their decisions to qualify are being tested. Thus, a time-series holdout is more likely to detect poor predictive ability, whereas a cross-sectional holdout is more likely to exaggerate the model's predictive ability.

To ensure adequate holdout and estimation sample sizes, the models are estimated on observations with fiscal years ending before December 31, 1976, and predictions are evaluated on firms with fiscal years ending on or after December 31, 1976. There are 218 qualified and 346 clean observations in the estimation sample, and 57 qualified and 95 clean observations in the holdout sample.

For each firm in the qualified sample, we read the audit opinion to classify the type of qualification issued by the auditor. The categories comprise going concern, litigation, asset realizing, and multiple. We classify opinions as going concern qualifications if the auditor disclaims an opinion, or expresses doubt about the firm's ability to survive as a going concern. We also classify opinions as going concern qualifications if the auditor expresses doubt about the firm's ability to finance its future activities, even if the auditor does not specifically question the firm's ability to survive as a going concern. Litigation qualifications arise when a lawsuit against the firm creates the uncertainty triggering the qualification. Asset realizing qualifications arise when the auditor indicates that the realizable value of an asset may be less than its book value. If the uncertainty encompasses both asset realizing and litigation, it is classified as multiple.[7]

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[5] Financial service firms are excluded because several of the financial variables used are inappropriate for firms in that industry. Financial distress models typically exclude firms in the financial service industry, or are estimated separately for those firms. Firms in that industry comprised approximately 11 percent of the qualified sample (concentrated in the 1973–1975 period), but only three percent of the clean sample.

[6] If seven industry dummy variables are added to the model to determine whether the financial and market variables capture more than industry membership, only one dummy variable has a coefficient significantly different from zero and the coefficients on the market and financial variables do not change materially.

[7] Approximately 40 percent of the sample firms with clean opinions have financial statement footnotes that refer to contingencies similar in nature to those mentioned in the qualified opinions, but presumably not in probability or magnitude. (See AICPA [1986, Au 9509.14], or Banks and Kinney [1982].) We coded those contingencies similarly to the qualification categories, but we did not ascertain whether the contingencies were "new" (first-time). Preliminary tests revealed no differ-

The estimation sample comprises 27 (12.4 percent) going concern opinions, 94 (43.1 percent) litigation qualifications, 71 (32.6 percent) asset realizing qualifications, and 26 (11.9 percent) multiple qualifications. The holdout sample consists of 12 (21.1 percent) going concern opinions, 27 (47.3 percent) litigation, 13 (22.8 percent) asset realizing, and five (8.8 percent) multiple qualifications.

Going concern qualifications are more "severe" because they call into question the firm's ability to survive. Consequently, signs of financial distress manifested by market and financial statement variables should be more obvious for firms with going concern qualifications than for firms with other types of qualifications. Signs of financial distress should be less obvious in the financial statement variables of firms with litigation qualifications because the liability for the lawsuit is not recorded in the financial statements. Many financially secure firms are sued, although auditors of financially troubled firms are more likely to consider a given lawsuit material. We expect (and the results confirm the prediction) that predictions of litigation qualifications will be less accurate than other qualifications. Asset-realizing qualifications question the firm's ability to recover the book value of a subset of its assets, but do not question the entire firm's survival. Thus, financial statement and market variables should indicate fewer signs of distress for firms with asset realizing qualifications than firms with going concern opinions, but greater than firms with litigation qualifications. Firms with multiple qualifications should lie between going concern and asset realizing qualifications.

For each firm in the first-time qualification sample, we also examine the opinion for the fiscal year after the qualification to determine whether the subsequent opinion was clean or qualified, and, if qualified, the type of qualification. Approximately 25 percent of the first-time qualifications receive a clean opinion in the subsequent year, while 75 percent receive another qualification. We predict that firms with clean opinions subsequent to a first-time qualification will have market and financial statement data indicating an improvement relative to their qualification year whereas firms with subsequent qualifications will not experience that improvement.

II. VARIABLES ASSOCIATED WITH AUDITORS' DECISIONS

Financial Statement Variables

Five financial statement variables are included in the model: change in leverage, the changes in two asset composition measures (the ratio of receivables to total assets, and the ratio of inventories to total assets), a size measure (total assets), and whether the firm reported a loss in the year of the qualification.[8] The change form of the ratios should help capture the change in state that is associated with the change in the audit opinion from clean to qualified.[9] Further

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ences in the financial statement or market variables for clean firms with and without contingencies. We do not distinguish between clean firms with or without contingencies in the remainder of the paper. Those results are inconsistent with Banks and Kinney [1982], who find that annual stock market performance for firms with unqualified opinions and new (first-time) contingencies is approximately five percent lower than for firms with unqualified opinions and no new contingencies when matched by industry and the sign of unexpected earnings.

[8] Results are inferior if net income is included as a continuous variable and scaled by either net worth or total assets.

[9] Most studies in the bankruptcy prediction literature rely on the level of the variables rather than the change in the variables. The results in this paper are essentially unaltered if levels are substituted for changes.

EXHIBIT 1

DEFINITION OF FINANCIAL STATEMENT AND MARKET VARIABLES

Variable	*Definition*
$\Delta\frac{\text{TOTAL LIABILITIES}}{\text{TOTAL ASSETS}}$	Change in ratio of total liabilities (including capitalized leases) to total assets (including capitalized leases).[a]
$\Delta\frac{\text{RECEIVABLES}}{\text{TOTAL ASSETS}}$	Change in ratio of receivables to total assets (including capitalized leases).[a]
$\Delta\frac{\text{INVENTORY}}{\text{TOTAL ASSETS}}$	Change in ratio of inventory to total assets (including capitalized leases).[a]
BOOK VALUE OF TOTAL ASSETS	Natural logarithm of book value of total assets at the end of the fiscal year.
CURRENT YEAR LOSS	0/1 dummy variable set to one if income available for common is negative for the current year.
TIME LISTED	0/1 dummy variable set equal to one if the firm has been listed on the New York or American Stock Exchange for more than five years.
ΔBETA	Change in beta, the slope coefficient of market model regression.[b]
ΔRESIDUAL STANDARD DEVIATION OF RETURNS	Change in the residual standard deviation from market model regression.[b]
RETURNS—INDUSTRY RETURN	Common stock returns (including dividends) minus an equally weighted industry index.[c]

Source of financial statement variables: Compustat Merged Annual Industrial File.

Source of market variables: Center for Research in Security Prices (CRSP) Daily Returns File.

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[a] The change in financial statement variables (Δ) represents the difference between the book value of the variable at the end of the fiscal year and its book value at the end of the previous fiscal year.

[b] The change in market variables represents the difference between the variable measured over the 260 trading days prior to the fiscal year end and the 260 trading days prior to the previous fiscal year end. Observations are eliminated if there are fewer than 100 trading days available in each fiscal year. Market model regressions are based on the equally weighted NYSE and AMEX Index.

[c] Estimated over 260 trading days prior to fiscal year end. Observations are eliminated if there are fewer than 100 trading days available in that period. Industry classifications are based on the following SIC codes:

Agriculture, forestry, and fishing	(100-999)
Mining	(1000-1499)
Construction	(1500-1999)
Manufacturing	(2000-3999)
Transportation and utilities	(4000-4999)
Wholesale	(5000-5199)
Retail	(5200-5999)
Services	(7000-8999)

details of the financial variables appear in Exhibit 1.

The financial variables reflect the financial condition of firms, and the potential costs associated with inappropriate audit opinions. The specific variables measuring financial health (leverage, size, and whether a loss was reported) are included because of their success in univariate and multivariate statistical models that predict financial distress.[10] Two factors suggest that a qualified audit opinion is more likely when a firm's financial condition deteriorates. First, some qualifications, such as going concern qualifications, actually raise questions about the firm's ability to finance its ongoing activities. Second, auditors of firms that are performing poorly are more likely to decide that contingencies of a given magnitude are material.

The asset composition variables are included because of previous research on auditors' exposure to lawsuits. St. Pierre and Anderson [1984] survey accounting and auditing disputes in 130 lawsuits against auditors and find a high frequency of suits involving inventories and receivables. Simunic [1980] argues in his pricing study that audit fees are higher for firms with relatively large amounts of inventories and receivables because those accounts are the subject of more lawsuits against auditors.

Market Variables

Four stock market variables are used in this study to predict audit qualifications: time listed, change in beta, change in residual standard deviation of returns, and returns less industry returns. Calculation of the variables is described in Exhibit 1.

Stock market variables are included as potential predictors of the audit qualification decision for two reasons. First, market return measures capture information above and beyond that reported in the financial statements. Market return measures may be correlated with the auditor's information set, or the auditor may use market return measures to infer information incorporated in market prices.[11] The results in the paper are based on returns minus the return on an industry index.[12] Second, the variability measures reflect the risk of lawsuits against auditors. Lawsuits against auditors usually take place after the value of the equity falls precipitously because plaintiffs need only establish reliance on financial statements that did not disclose major uncertainties. The greater the variability of a firm's returns, the higher the probability of a large decline in stock price and, we argue, the more likely an auditor will qualify a firm's opinion. Two alternative variability measures are tested (beta and residual standard deviation from the market model).[13]

The "time listed" variable is included because "young" firms are more likely to experience financial distress. Thus, auditors should qualify the financial statements of "young" firms more frequently. The time-listed variable is defined as a 0/1 dummy and set equal to one if the firm has been listed on the New York or American Stock Exchange for more than five years at the time of the qualification.[14]

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[10] See Zmijewski [1984] for a review of these models, and Altman and McGough [1974] for their application in an audit context.

[11] Ohlson [1980] notes that financial distress prediction models do not include stock market variables. Ohlson argues that such data would improve the predictive ability of the models. Beaver's [1968] univariate results for bankruptcy predictions suggest that changes in stock price are more timely predictors of bankruptcy than univariate financial statement variables. Kaplan and Urwitz [1979] predict bond ratings and their variables include market risk measures.

[12] Alternative return variables capture information about the firm—returns, returns minus the market, returns minus the industry return, and abnormal returns measured relative to a pricing model, such as the market model. Returns minus the market and returns minus an industry index yield similar results, so reported results are based on only returns minus the industry index. (Details of the industry indexes are contained in Exhibit 1). The results using returns and abnormal returns are very similar to each other, but inferior to those reported.

[13] The variance of returns on a firm's stock is highly correlated with residual variance. Empirically, residual variance yields superior results.

All variables are measured for the year of the qualification, i.e., "flow" variables, such as net income and returns minus the industry, are measured for the fiscal year of the qualification, and "stock" values, such as book value of total assets, are measured at the end of the fiscal year. For the types of audit qualifications in this paper, the primary audit work usually occurs after fiscal-year end and auditors have access to preliminary financial data for the current year when determining either what opinion they should issue, or what opinion other auditors probably would issue under similar circumstances.[15]

III. Data Analysis

Statistical Methods[16]

As discussed above, the estimation sample of qualified and clean opinions is choice-based because qualified opinions are deliberately oversampled relative to the population proportion. Statistical classification models which ignore the choice-based sampling procedures produce asymptotically biased coefficient estimates. (See Manski and Lerman [1977] and Manski and McFadden [1981].)[17] To correct for the oversampling of qualifications, a probit model is employed with weighted exogenous sample maximum likelihood (*WESML*) procedures to estimate the multivariate model. With random sampling, the probit model assumes that

$$Q_i^* = \beta' X_i + \tilde{\epsilon}_i \; (i=1, \ldots N)$$

where

$$\tilde{\epsilon}_i \sim NID(0,\sigma^2) \text{ and}$$

$$Q_i = \begin{cases} 1 \text{ if } Q_i^* > 0 \\ 0 \text{ otherwise} \end{cases}$$

Thus,

$$\begin{aligned} \text{Prob}\,(Q_i=1) &= \text{Prob}\,(\epsilon_i > -\beta' X_i) \\ &= 1-\Phi(-\beta' X_i) \end{aligned}$$

where Φ is the cumulative distribution function for a unit normal distribution.

The coefficients, $\hat{\beta}$, are estimated by maximizing the log-likelihood function (L):

$$L = \sum_{i=1}^{N} (Q_i)\, ln\,[\Phi(\beta' X_i)] + \sum_{i=1}^{N} (1-Q_i)\, ln\,[1-\Phi(\beta' X_i)]$$

To account for choice-based sampling, *WESML* weights the log-likelihood function according to the proportion of qualified opinions in the sample (α_s) and in the population (α_p).[18] Thus *WESML*

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[14] This variable is not tested in continuous form because we have ready access only to the time listed since July 2, 1962 (the start of CRSP daily return history for NYSE and AMEX companies) and our sample begins in 1969. The dummy variable switch is set at five years because firms less than five years old fail more frequently than older firms. (See Dun and Bradstreet [1985].)

[15] Prior year data may be more appropriate for users of the model outside the firm who do not have access to unannounced year-end results. In unreported tests, the predictive power of the model is substantially lower if the model relies only on data from the year prior to the qualification, but the coefficients of the model and differences in the estimated probabilities for clean and qualified firms still produce statistically significant results. These results constitute a lower bound, because even outside users have access to (unaudited) quarterly information.

[16] John Abowd and David Hsieh generously provided advice on the econometric issues addressed in this section. David Hsieh also supplied the maximum likelihood computer routines.

[17] Zmijewski [1984] discusses and demonstrates this issue in the context of bankruptcy prediction, as does Palepu [1986] in the context of acquisition target prediction.

[18] Hsieh, Manksi, and McFadden [1985] discuss the statistical procedures underlying *WESML*, together with two alternative estimation techniques (conditional maximum likelihood and full information concentrated maximum likelihood). McFadden, Hsieh, and Manski [1983] apply the techniques to study the association between coffee consumption and the incidence of pancreatic cancer.

TABLE 1

SUMMARY STATISTICS—INDEPENDENT VARIABLES FOR ESTIMATION SAMPLE
MEANS, MEDIANS, STANDARD DEVIATIONS, AND TEST STATISTICS
ESTIMATION SAMPLE OF 218 FIRMS WITH QUALIFIED AUDIT OPINIONS
AND 346 FIRMS WITH UNQUALIFIED OPINIONS

	Means		*Medians*		*Standard Deviations*		*Test Statistics*[1] (*P-Values*)	
Variable	*Qualified*	*Clean*	*Qualified*	*Clean*	*Qualified*	*Clean*	*t-Statistic*	χ^2
Time Listed (0/1)	0.161	0.239					−2.341 (0.010)	
Returns-Industry (percent)	−0.086	0.013	−0.072	0.008	0.175	0.136	−7.129 (0.000)	24.787 (0.000)
Current Year Loss (0/1)	0.349	0.039					9.104 (0.000)	
Book Value of Total Assets (Log $ millions)	4.588	4.595	4.375	4.564	1.588	1.439	−0.051 (0.480)	1.862 (0.172)
Δ Beta	−0.201	−0.040	−0.164	0.004	0.491	0.314	−4.323 (0.000)	23.103 (0.000)
Δ Residual Std. Dev. Returns (percent)	0.395	0.065	0.301	−0.008	0.870	0.606	4.912 (0.000)	15.764 (0.000)
Δ (Receivables/Total Assets)	−0.003	0.060	−0.003	0.010	0.047	0.313	−3.687 (0.000)	12.973 (0.000)
Δ (Inventory/Total Assets)	−0.010	−0.025	−0.002	−0.004	0.057	0.299	0.962 (0.168)	0.034 (0.854)
Δ (Total Liabilities/Total Assets)	0.046	0.004	0.023	0.000	0.108	0.059	5.197 (0.000)	17.160 (0.000)

[1] The *t*-statistic (χ^2-statistic) tests whether the means (medians) of the qualified and clean samples are different. For 0/1 variables, a *Z*-statistic tests whether the proportions are different, and the median, standard deviation, *t*-statistic, and χ^2-statistic are not calculated. *P*-values are in parentheses.

maximizes the weighted log-likelihood function:

$$L^{WESML} = [\alpha_p/\alpha_s] \sum_{i=1}^{N} (Q_i)\, ln[\Phi(\beta' X_i)] + [(1-\alpha_p)/(1-\alpha_s)] \sum_{i=1}^{N} (1-Q_i)\, ln[1-\Phi(\beta' X_i)]$$

The *WESML* probit model is estimated with the nine independent variables contained in Exhibit 1. Thus,

$$[X_i] = \left| \begin{array}{l} \text{(Constant)} \\ \text{(Time Listed)}_i \\ \text{(Returns} - \text{Industry)}_i \\ \text{(Current Year Loss)}_i \\ \text{(Book Value of Total Assets)}_i \\ \Delta\text{(Beta)}_i \\ \Delta\text{(Residual Standard Deviation of Returns)}_i \\ \Delta\text{(Receivables/Total Assets)}_i \\ \Delta\text{(Inventory/Total Assets)}_i \\ \Delta\text{(Total Liabilities/Total Assets)}_i \end{array} \right|$$

Table 2

Weighted Exogenous Sample Maximum Likelihood (*WESML*) Probit: Coefficients, Asymptotic t-Statistics, Pseudo-R^2 and χ^2-Statistics of Log Likelihood Ratio for Year of Qualification

Prior Probability of Qualified Opinion: 0.04697

		Coefficients (Asymptotic t*-Statistics in Parentheses)*		
Variable (Δ≡Value at t−Value at $t-1$)	*Predicted Sign*	*All Observations [218 Qualified] [346 Clean]*	*Excluding Litigation [124 Qualified] [346 Clean]*	*Litigation Only [94 Qualified] [346 Clean]*
Constant		−1.953	−2.337	−1.629
		(−10.235)	(−8.867)	(−6.776)
Time Listed (0/1)	−	−0.340	−0.353	−0.300
		(−2.280)	(−1.727)	(−1.765)
Returns-Industry (percent)	−	−1.394	−1.607	−1.103
		(−2.925)	(−2.632)	(−1.895)
Current Year Loss (0/1)	+	1.119	1.392	0.731
		(6.226)	(7.030)	(3.455)
Book Value of Total Assets (Log $ Millions)	−	0.016	0.066	−0.028
		(0.438)	(1.431)	(−0.576)
Δ Beta	+	−0.345	−0.456	−0.292
		(−2.131)	(−2.102)	(−1.583)
Δ Residual Standard Dev. Returns (percent)	+	0.317	0.292	0.310
		(4.508)	(3.535)	(3.437)
Δ (Receivables/Total Assets)	+	−0.262	−0.198	−0.314
		(−1.572)	(−0.936)	(−2.332)
Δ (Inventory/Total Assets)	+	0.424	0.491	0.342
		(3.111)	(2.810)	(2.496)
Δ (Total Liabilities/Total Assets)	+	1.782	2.580	0.717
		(2.113)	(1.996)	(0.736)
Pseudo-R^2[a]		0.189	0.290	0.090
χ^2-Statistic on log likelihood ratio[b]		40.289	51.584	15.041
P-Value		0.000	0.000	0.131

[a] The pseudo-R^2 is equal to one less than the ratio of the log likelihood at convergence for the *WESML* probit model (unconstrained) to the log likelihood with only the constant term in the model (constrained).

[b] Minus two times the difference in the log likelihood of the unconstrained and constrained models is asymptotically distributed χ^2, with degrees of freedom equal to the difference in the number of parameters of the two models.

WESML Probit Estimates

Table 1 reports the means and medians of the independent variables for the qualified and clean estimation samples, together with t-statistics (χ^2−statistics) to test whether the means (medians) of the two samples differ. P-values on the test statistics indicate significant differences between the clean and qualified samples for all variables except the book value of total assets and the change in the ratio of inventory to total assets.

Table 2 contains the predicted signs, estimated coefficients, asymptotic t-statistics, and two goodness-of-fit measures (the pseudo R^2 and the likelihood ratio test) from the *WESML* probit model.[19] The estimated models assume that the proportion of first-time qualified opinions in the population, α_p, is .04697. Details of the estimation of this proportion are contained in the Appendix, together with some sensitivity analysis for alternative estimates. The results and conclusions are not greatly affected by allowing α_p to vary from .02622 to .10718.

Table 2 reports the results for the entire estimation sample, and then for the estimation sample excluding litigation qualifications and for the sample of litigation qualifications separately. As discussed previously, the financial variables should have lower explanatory power for litigation qualifications because those qualifications are less likely to be associated with a firm's financial viability.

Consider first the results for the estimation sample of all qualified and clean opinions. The current year loss variable has a positive coefficient that is at least six standard errors from zero. The coefficient on returns minus the industry is negative and approximately three standard errors from zero. The coefficient on the time-listed variable is negative as predicted, and approximately two standard errors from zero. The coefficients on the change in residual standard deviation of returns and the change in the debt/total assets ratio are positive as predicted, with t-statistics of 4.51 and 2.11. The coefficients on book value of assets, change in beta, and change in asset composition variables are generally insignificant or their signs are opposite to the direction predicted (except for the change in the ratio of inventory to total assets).[20] The pseudo-R^2 of the model is 18.9 percent and the χ^2-statistic for the likelihood ratio test has a P-value of 0.000.

Consider next the models estimated for the sample excluding litigation qualifications and for the sample of litigation qualifications separately. In general, the model excluding litigation produces the strongest statistical results, and the model for the litigation subsample produces weak results. Three variables produce coefficients that are reliably different from zero in the predicted direction regardless of the sample—returns minus the industry, change in residual standard deviation of returns, and current year loss.

Estimated Probabilities

Figure 1 and Table 3 summarize the distribution of estimated qualification probabilities from the probit model for both the estimation and the holdout samples. Probabilities are calculated using the coefficients in Table 2 for the entire estimation sample. Table 3 contains t-statistics (χ^2 – statistics) to test for differences in the means (medians) of the estimated probabilities for clean and qualified firms.

The mean and median estimated probabilities (0.202 and 0.070) are higher for the 218 qualified firms in the estimation sample than the mean and median probabilities (0.040 and 0.027) for the 346 firms with clean opinions, and the P-values for test statistics on the differences are 0.000. The figure provides

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[19] The pseudo-R^2 is equal to one less the ratio of the log likelihood at convergence for the *WESML* probit model (unconstrained) to the log likelihood with only the constant term in the model (constrained), and is analogous to the R^2 of a regression. (See Maddala [1983, pp. 37–41].) The likelihood ratio statistic (minus twice the ratio of the likelihoods of the constrained and unconstrained models) is another goodness-of-fit measure, and is distributed asymptotically χ^2, with degrees of freedom equal to the number of independent variables other than the constant.

[20] The correlation matrix among independent variables (not reported) indicates some statistically significant correlations, but no correlation exceeded 0.45. Estimated signs and significance of the coefficients are generally insensitive to the inclusion or exclusion of the other independent variables.

FIGURE 1

CUMULATIVE DISTRIBUTION OF ESTIMATED PROBABILITIES FOR THE ESTIMATION (HOLDOUT) SAMPLE: BASED ON 218 (57) QUALIFIED AND 346 (95) CLEAN OBSERVATIONS

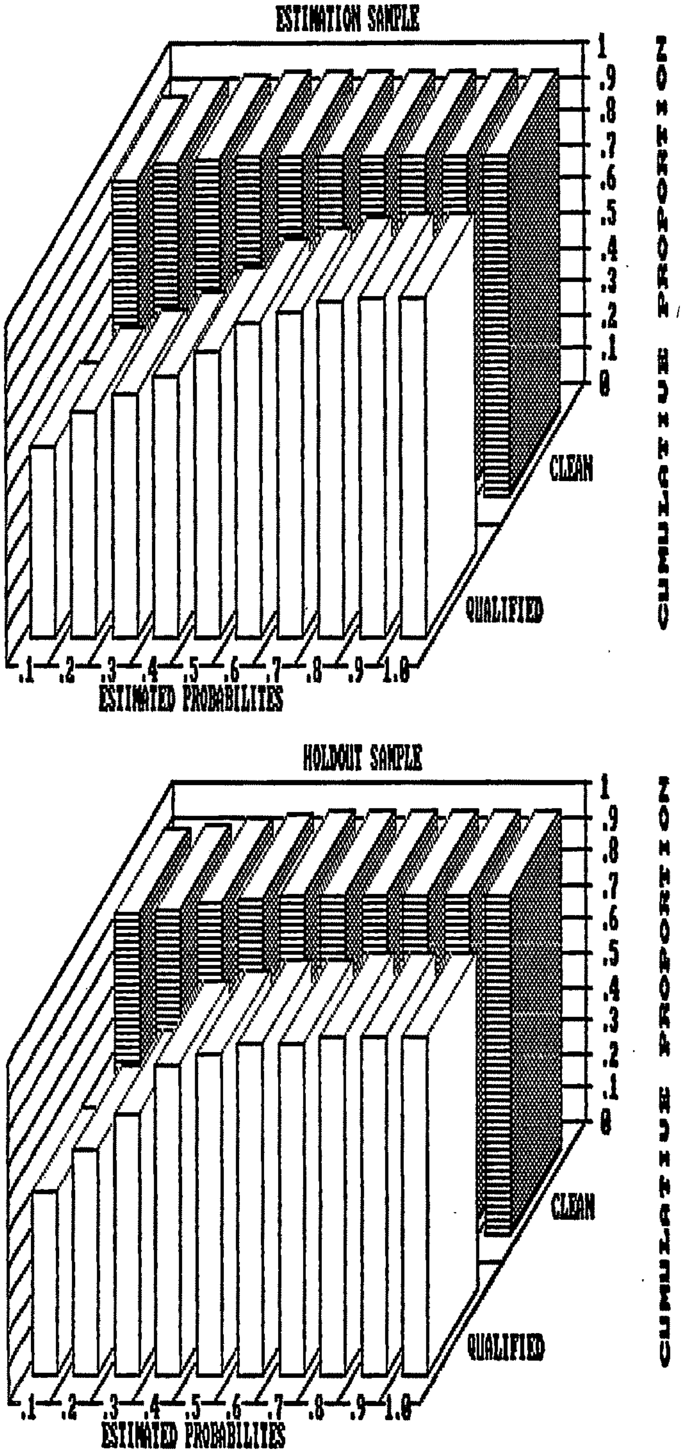

TABLE 3

ESTIMATED PROBABILITIES OF TYPES OF QUALIFICATIONS FOR YEAR OF INITIAL QUALIFICATION: MODEL ESTIMATED IN YEAR OF QUALIFICATION

	Estimation Sample of 564 (218 qualified, 346 clean)						*Holdout Sample of 152 (57 qualified, 95 clean)*					
	Type of Sample		*Type of Qualification*				*Type of Sample*		*Type of Qualification*			
Estimated Probability	*Qualified*	*Clean*	*Going Concern*	*Litigation*	*Asset Realizing*	*Multiple*	*Qualified*	*Clean*	*Going Concern*	*Litigation*	*Asset Realizing*	*Multiple*
Mean	.202	.040	.444	.127	.183	.277	.156	.040	.305	.090	.115	.260
Median	.070	.027	.491	.045	.077	.077	.062	.021	.205	.034	.037	.273
Std. Dev.	.232	.052	.239	.183	.201	.281	.174	.070	.240	.114	.130	.118
t-Statistic[a]		10.185		6.385	5.035	2.332		4.821		2.965	2.433	0.521
P-Value		0.000		0.000	0.000	0.012		0.000		0.005	0.013	0.305
χ^2-Statistic[b]		62.977		20.381	14.010	0.943		20.089		7.601	3.205	0.228
P-Value		0.000		0.000	0.000	0.332		0.000		0.006	0.073	0.633
Number	218	346	27	94	71	26	57	95	12	27	13	5
Minimum	.001	.001	.016	.007	.001	.004	.005	.002	.010	.005	.007	.055
Maximum	.939	.386	.939	.795	.735	.864	.804	.483	.804	.348	.468	.357

[a] Tests difference between means of qualified and clean samples, and difference between means of going concern and other types of qualifications.

[b] Tests difference between medians of qualified and clean samples, and difference between medians of going concern and other types of qualifications.

additional evidence of the differences in the estimated probabilities. For example, 92.8 percent of the clean opinions have estimated probabilities less than 0.1, compared with 56.0 percent of the qualified opinions, and 100 percent of the clean opinions have estimated probabilities below 0.4 compared with 76.6 percent of the qualified opinions. Results in Table 3 are not as strong for the holdout sample as for the estimation sample, but the test statistics indicate that the differences remain reliable. The *P*-values for the test statistics are both 0.000. The weaker results for the holdout sample are consistent with increased sampling error in the smaller sample, overfitting with the estimation sample, and/or violation of stationarity assumptions because of structural shifts in the economic incentives facing auditors.

Types of Qualifications

As discussed previously, estimated probabilities from the probit model should differ across types of qualifications. Table 3 summarizes the probability scores according to the type of qualification for the estimation sample and holdout samples. The mean and median estimated probabilities of firms with going concern opinions are higher than those of firms with asset realizing qualifications, which in turn are greater than those with litigation qualifications, for both the holdout and estimation samples. The estimated probability of a going concern qualification is approximately three times the estimated probability of a litigation qualification. The estimated probabilities of going concern and multiple qualifications are not significantly different.

Misclassification Costs

A cutoff score is selected to minimize the expected cost of misclassification in the estimation sample. The cost-minimizing cutoff score is selected iteratively by calculating the expected misclassification costs per the equation below, using each of the probability estimates in the estimation sample as a candidate cutoff score. For example, if the estimation sample contains 218 qualified opinions and 346 clean opinions, there are 564 estimated probabilities that are candidate cutoff scores. Firms with estimated probabilities above the cutoff score are classified as qualified; firms with estimated probabilities less than or equal to the cutoff score are classified as clean. If a firm with a qualified opinion is classified as clean by the model, the error is labeled type I. If a firm with a clean opinion is classified as qualified by the model, the error is labeled type II.

The expected cost of misclassification with the model, EC_M, depends on the conditional probabilities of type I and II errors (P_I and P_{II}), the costs of type I and II errors (C_I and C_{II}), and the prior probabilities of encountering firms with qualified and clean opinions ($P(Q)$ and $P(C)$):

$$EC_M = P_I \cdot P(Q) \cdot C_I + P_{II} \cdot P(C) \cdot C_{II}$$

where

$P_I = P(\text{Predict } C \mid Q)$ and
$P_{II} = P(\text{Predict } Q \mid C)$

The prior probability of encountering a qualification, α_p, is part of the *WESML* procedure. Thus, $P(Q) = \alpha_p = 0.04697$ and $P(C) = 1 - \alpha_p = 0.95303$. The conditional probabilities of type I and II errors (P_I and P_{II}) are calculated by dividing the number of type I and II errors (produced by classifying according to the cutoff score) by the number of qualified and clean opinions, respectively.

The costs of type I and type II errors are not measured. Instead, the expected cost of the model is calculated under alternative assumptions about the relative cost of type I and II errors ranging from 1:1 to 20:1. Observations in the holdout sample are then classified with cutoff scores that minimize the expected cost of misclassification in the estimation sample for each relative cost of type I and type II errors. Misclassification costs are calculated for the holdout sample using the proportion of clean and qualified opinions classified incorrectly in the holdout sample for each relative cost of type I and II errors.[21]

The expected cost of misclassification using the model should be judged relative to a benchmark, preferably the cost of the next best alternative method of distinguishing between qualified and clean opinions. In the absence of information about alternative systems, the expected cost of the model is compared with the expected cost of a naive strategy of classifying all firms as clean.[22] It is necessary, but not sufficient, that the model outperform such a strategy if it is to be cost-effective.[23]

Panel A of Table 4 contains cutoff scores and information about the accuracy and misclassification costs of the model for both the estimation and holdout samples. In the estimation sample, the misclassification costs are lower than the naive strategy for all relative costs of type I and II errors. Even at equal costs, the model is more efficient with a relative cost of 0.761. The performance improves as the relative cost of type I errors increases. (It can be argued that, as the relative cost increases, the naive strategy becomes a less informative benchmark.) As expected, the optimal cutoff score and the proportion of type I errors fall as the relative cost of type I errors increases, reflecting the changing tradeoff between type I and II errors.

The point estimates of misclassification costs are higher for the holdout sample than the estimation sample. If type I and type II errors are equally costly, the model cost exceeds the cost of the naive strategy, but at higher relative levels of type I costs, the model dominates. The misclassification errors made by applying the cutoff scores to the holdout sample are consistent with the pattern observed in the estimation sample. With equal costs 52 (98.1 percent) of the 53 errors are type I, and at a cost ratio of 20:1, only 26 (68.4 percent) of 38 errors are type I. Thus, the tests on the holdout sample support the in-sample performance of the model.

Panel B of Table 4 summarizes the ability of the model to predict different classes of qualifications for both the estimation and holdout samples. Panel B indicates the proportion of type I and II errors for various levels of relative costs

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[21] The holdout sample of 152 firms is choice-based, like the estimation sample, and contains 57 qualified firms (37.5 percent) and 95 clean firms (62.5 percent). Consequently, the conditional probabilities of type I and type II errors are weighted by the prior probabilities, α_p (0.04697) and $1-\alpha_p$ (0.95303), to calculate expected misclassification costs for the holdout sample. For example, suppose that the model makes 40 type I errors and four type II errors when the relative costs of type I to type II errors is five to one. Then, the conditional probabilities of type I and II errors are 0.702 (40/57) and 0.042 (4/95). The expected cost of misclassification is 0.20489 (i.e., $0.702 \times 0.04697 \times 5.00 + 0.042 \times 0.95303 \times 1.00$).

[22] If the costs of type I errors are relatively high, classifying all firms as qualified produces a benchmark with lower expected costs. With a prior probability of a qualification of 0.04697, such a strategy is superior to the one we chose once the relative costs exceed 21.29:1 ($1/\alpha_p$). For prior probabilities incorporated in the sensitivity analysis in the Appendix, the alternative naive strategy is adopted as the benchmark when it is optimal. Randomly classifying firms as clean or qualified according to the population proportions ($1-\alpha_p$ and α_p) produces an alternative benchmark with higher misclassification costs than the naive benchmark used.

[23] Some audit firms now use statistical classification models in the audit process, but we do not investigate the cost of maintaining and applying statistical models. The naive strategy is costless in terms of out-of-pocket costs, but it would be difficult to defend in a suit against the auditor.

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TABLE 4

MISCLASSIFICATION COSTS AND PROBABILITY OF ERRORS FOR YEAR OF QUALIFICATION FOR VARIOUS LEVELS OF RELATIVE COSTS

Panel A: Misclassification Costs and Errors

		Estimation sample of 564 (218 qualified, 346 clean)			*Holdout Sample of 152 (57 qualified, 95 clean)*		
		Probability of Classification Errors from 218 Qualified and 346 Clean			*Probability of Classification Errors from 57 Qualified and 95 Clean*		
Relative Costs of Type I and Type II Errors[a]	*Cut-Off Probability*	*Type I*[a]	*Type II*[a]	*Cost of Model Errors Relative To Cost of Errors From Naive Strategy*[b]	*Type I*[a]	*Type II*[a]	*Cost of Model Errors Relative To Cost of Errors From Naive Strategy*[b]
1:1	.3860	.761	.000	.761	.912	.011	1.126
5:1	.2175	.674	.017	.745	.702	.042	.873
10:1	.1098	.569	.061	.692	.544	.053	.651
15:1	.0571	.431	.136	.615	.456	.126	.627
20:1	.0571	.431	.136	.569	.456	.126	.584

Panel B: Probability of Type I Errors by Type of Qualification

	Estimation Sample of 564 (218 qualified, 346 clean)					*Holdout Sample of 152 (57 qualified, 95 clean)*				
		Type of Qualification					*Type of Qualification*			
Relative Costs	*Total*	*Going Concern*	*Litigation*	*Asset Realizing*	*Multiple*	*Total*	*Going Concern*	*Litigation*	*Asset Realizing*	*Multiple*
1:1	.761	.333	.872	.831	.615	.912	.667	1.000	.923	1.000
5:1	.674	.222	.819	.704	.539	.702	.500	.815	.846	.200
10:1	.569	.148	.723	.535	.539	.544	.167	.778	.539	.200
15:1	.431	.111	.596	.366	.346	.456	.167	.630	.462	.200
20:1	.431	.111	.596	.366	.346	.456	.167	.630	.462	.200
# in Category	218	27	94	71	26	57	12	27	13	5

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[a] Type I error is defined as classifying observation as clean when it is qualified. Type II error is defined as classifying observation as qualified when it is clean.

[b] Naive strategy is defined as classifying all firms into a category with higher prior probability (i.e., clean). Error costs are calculated assuming the proportion of qualifications in the population is 0.04697.

using the same cutoff scores as in Panel A.[24] As expected, the model predicts going concern opinions most accurately, followed by multiple qualifications, asset realizing, and finally litigation for both estimation and holdout samples. (Multiple qualifications in the holdout sample with equal relative costs are an exception.) The proportion of type I errors decreases in all categories as the relative cost of type I errors increases.

Subsequent Qualifications

All of the above results focus on first-time qualifications. The estimated probabilities for subsequent qualifications can be calculated by applying the model (estimated in the year of the first-time qualification) to the financial and market variables for the year after the qualification. Table 5 summarizes the probability estimates for three sample types: firms with qualified opinions in both years, firms with qualified opinions in the first year only, and firms with clean opinions in both years. For firms with qualifications in the subsequent year, estimated probabilities are indicated by type of qualification.

The estimated probabilities behave as predicted for the year subsequent to the first qualification. Estimated probabilities are significantly higher if both years are qualified than if only the first year is qualified, and, in turn, if both years are clean. The estimated probabilities also rank as predicted for the types of qualification in the subsequent year. The highest mean probabilities are estimated for going concern opinions, the lowest for litigation, and asset realizing probabilities lie in between.[25]

IV. CONCLUSIONS

This paper provides evidence that a probit model using publicly available financial and market data predicts whether an auditor will issue a first-time qualified opinion in the current year, or another qualified opinion in the subsequent year. Moreover, the estimated probability scores from the model differ in a predicted manner across different types of opinions. Going concern opinions have the highest scores and the highest accuracy rate in prediction. Litigation qualifications have the lowest scores and the lowest accuracy rate in prediction. Asset realizing qualifications represent an intermediate case. The model developed in the paper takes into account different relative costs of type I and type II errors and considers the prior probability of an audit qualification.

There is information in market prices that is correlated with the auditor's decision since market variables included in the model have explanatory power beyond that contained in the financial statement variables in the model. Further, there is information in the financial statement variables that is correlated with the auditor's decision because the financial statement variables have incremental explanatory power.

The model developed in the paper can serve as a decision aid for auditors when predicting what opinion other auditors would issue in similar circumstances, when evaluating potential clients, in determining the scope of an audit for existing clients, in peer reviews, to control quality within firms, and as a defense in lawsuits. Researchers can use

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[24] Cutoff scores could be calculated for each type of qualification, but that is beyond the scope of this paper since it leads to 20 possible types of misclassification errors, each with its own cost.

[25] Subsequent qualifications offer some interesting extensions. For some firms, the subsequent qualification is more "severe" than the first-time qualification (e.g., a going concern qualification subsequent to a litigation qualification). For other firms, the subsequent qualification is less severe, with a clean opinion the least severe of all. The transition matrix for these qualifications requires a polychotomous dependent variable.

TABLE 5

SUMMARY OF ESTIMATED PROBABILITIES FOR YEAR SUBSEQUENT TO INITIAL QUALIFICATION MODEL: COEFFICIENTS ESTIMATED IN YEAR OF QUALIFICATION, VALUES OF VARIABLES FROM YEAR SUBSEQUENT TO QUALIFICATION

	Estimation Sample of 526							*Holdout Sample of 146*						
	Type of Sample			*Type of Qualification in Subsequent Year*				*Type of Sample*			*Type of Qualification in Subsequent Year*			
	Qualified							*Qualified*						
Estimated Probability	*Both Years*	*First Year Only*	*Clean Both Years*	*Going Concern*	*Litigation*	*Asset Realizing*	*Multiple*	*Both Years*	*First Year Only*	*Clean Both Years*	*Going Concern*	*Litigation*	*Asset Realizing*	*Multiple*
Mean	.149	.095	.059	.382	.090	.165	.155	.181	.040	.047	.365	.124	.144	NA
Median	.043	.044	.030	.331	.029	.050	.055	.074	.024	.024	.177	.054	.023	NA
Std. Dev.	.209	.153	.095	.233	.171	.206	.206	.205	.059	.081	.301	.144	.201	NA
t-Statistic[a]		1.964	4.973		4.442	3.045	3.054		3.513	3.505		1.883	1.387	NA
P-Value		0.026	0.000		0.000	0.003	0.003		0.001	0.001		0.054	0.099	
χ^2-Statistic[b]		0.006	6.528		11.086	13.279	10.365		6.621	13.216		2.741	0.017	NA
P-Value		0.937	0.011		0.001	0.000	0.001		0.010	0.000		0.098	0.895	
Number	144	50	332	14	68	36	26	30	16	100	6	18	4	2
Minimum	.002	.004	.000	.014	.002	.003	.006	.002	.003	.001	.015	.002	.023	NA
Maximum	.931	.799	.564	.887	.931	.862	.736	.736	.251	.429	.736	.398	.443	NA

[a] Tests difference between means of qualified and clean samples and difference between means of going concern and other types of qualifications.

[b] Tests difference between medians of qualified and clean samples, and difference between medians of going concern and other types of qualifications.

the model to assess the extent to which a qualification could be expected based on publicly available data. Moreover, since the estimated probabilities differ across types of opinions, the severity of the qualification can be compared to its expectation. Although researchers must rely on publicly available data, auditors should be able to improve the model by incorporating information on the expected dollar magnitude of uncertainties and on the costs of misclassifications.

APPENDIX

WESML requires an estimate of the prior probability of observing a first-time qualified opinion in the population (α_p). This proportion can be estimated by sampling the population. However, we rejected such a direct approach because it is costly to determine whether an opinion in a particular year is a first-time qualification. Instead, we used the information obtained in the sampling process described in Section I and estimated α_p for the fiscal years 1973–1975, because the data collection procedures ensure that the sample of qualified opinions for those years from the *Disclosure Index* is virtually exhaustive, subject to CRSP and COMPUSTAT data availability. For those years, the qualified sample contains 217 firms with data available, or 72 firms per year. The average number of firms in the sampled population is 1,746 per year during 1973–1975. This estimate of the population is obtained by calculating the number of CRSP and COMPUSTAT firms with data available for the variables in the model (excluding firms in the financial services industries).

Some firms in the population receive qualifications in successive years so they have neither a first-time qualification nor a clean opinion. To estimate the number of firms in the population with first-time qualifications and clean opinions, we assume that the qualification process can be described as Markov with three states: clean opinions, first-time qualifications, and subsequent qualifications. Suppose that the population at a particular point in time consists of N firms, comprising N_c firms with clean opinions, N_f with first-time qualifications, and N_s with subsequent qualifications.[26] The transition matrix is shown in Table A1.

Of the 217 first-time qualifications, 213 have data available for the subsequent year. Of the 213 firms, 54 receive a clean opinion in the following year.[27] Thus, P_2 is 0.253. Given this estimate, the unknowns in equations 1 to 4 can be solved. With a total population of 1,746 firms, 72 firms with first-time qualifications, and a "transition probability" (P_2) of 0.253, the solution is:

N_c (no. of clean opinions)	1,461
N_f (no. of first-time qualifications)	72
N_s (no. of subsequent qualifications)	213
N (no. of firms in population)	1,746

Thus, $\alpha_p = 72 \div (72 + 1{,}461) = 0.04697$

The estimated α_p depends on the assumptions embedded in the Markov transition matrix described above,[28] and the estimates of three parameters: the total number of firms with data available

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[26] We appreciate Gary Eppen's advice on this formulation.

[27] The probability of a clean opinion after a first-time qualification in the 1973–1975 period differs from the probability reported for the entire estimation sample in Table 5. If the numbers in Table 5 are substituted (194 first-time qualifications with 50 clean opinions in the subsequent year), P_2 is 0.258 instead of 0.253.

[28] Note that we assume the process is stationary through time, whereas the incidence of qualified opinions varies through time with general economic conditions.

TABLE A1
TRANSITION MATRIX

	State in Period 2		
State in Period 1	*Clean Opinion*	*First-Time Qualification*	*Subsequent Qualification*
Clean Opinion	P_1	$1-P_1$	0
First-Time Qualification	P_2	0	$1-P_2$
Subsequent Qualification	P_2	0	$1-P_2$

Thus,

$$C \cdot P_1 + F \cdot P_2 + S \cdot P_2 = C \tag{1}$$
$$C \cdot (1-P_1) = F \tag{2}$$
$$F \cdot (1-P_2) + S \cdot (1-P_2) = S \tag{3}$$
$$C + F + S = 1 \tag{4}$$

where

$C = N_c/N$
$F = N_f/N$
$S = N_s/N$

in the population per year, the number of first-time qualifications per year, and the transition probability. We calculated 27 alternative values of the number of firms with clean opinions and the proportion of first-time qualifications to clean opinions (α_p) to allow extreme (but credible) values of the three parameters on either side of the values discussed above: 50, 72, and 100 first-time qualifications per year; 1,500, 1,746, and 2,000 firms in the population each year; and 0.150, 0.253, and 0.350 transition probabilities. The calculated values of α_p range from 0.02622 to 0.10718, compared with the value of 0.04697 employed in the paper.

The model contained in the paper is re-estimated for the 27 alternative values of α_p. The results for only five values are reported in the Appendix to reduce clutter, but the same patterns are observed in the comprehensive results. Table A2 summarizes the sensitivity of the estimated coefficients, *t*-statistics, pseudo-R^2, and likelihood ratio test of the estimated probit model for five values of α_p. For comparison purposes the same statistics are presented for unweighted probit, together with comparable statistics of OLS regression results. For the probit models, the major variation occurs in the constant, the pseudo-R^2, and the likelihood ratio test. Inferences about statistical significance of the slope coefficients are relatively insensitive to variations in α_p from 0.02622 to 0.10718. Variations in the pseudo-R^2 and the likelihood ratio test are due primarily to variation in the prior probabilities.

Panel A of Table A3 contains estimated probabilities for the five *WESML* models, the unweighted probit model, and the OLS regression. Statistical inferences are insensitive to the choice of α_p but the levels of estimated probabilities increase, as expected, with increases in α_p. Panel B of Table A3 contains details of the cutoff scores that minimize the expected costs of misclassification for each choice of α_p, together with details

TABLE A2

WEIGHTED EXOGENOUS SAMPLE MAXIMUM LIKELIHOOD (*WESML*) PROBIT, UNWEIGHTED PROBIT, AND OLS: COEFFICIENTS, ASYMPTOTIC *t*-STATISTICS (IN PARENTHESES), AND GOODNESS OF FIT MEASURES FOR VARIOUS ESTIMATES OF PRIOR PROBABILITY (ESTIMATION SAMPLE: 218 QUALIFIED, 346 CLEAN)

	Prior Probabilities of a Qualification for WESML *Probit Estimation*					*Probit Without* WESML[b]	*OLS Estimates*[e]
	0.02622	*0.03859*	*0.04697*[a]	*0.06982*	*0.10718*		
Constant	−2.205 (−11.911)	−2.041 (−10.859)	−1.953 (−10.235)	−1.772 (−9.092)	−1.544 (−7.623)	−0.652 (−2.951)	0.273 (4.14)
Time Listed (0/1)	−0.339 (−2.316)	−0.341 (−2.297)	−0.340 (−2.280)	−0.341 (−2.253)	−0.343 (−2.222)	−0.344 (−2.120)	−0.096 (−2.06)
Returns—Industry (percent)	−1.342 (−2.910)	−1.380 (−2.925)	−1.394 (−2.925)	−1.427 (−2.934)	−1.461 (−2.943)	−1.466 (−2.976)	−0.463 (−3.34)
Current Year Loss (0/1)	1.064 (6.132)	1.101 (6.201)	1.119 (6.226)	1.153 (6.267)	1.185 (6.282)	1.174 (6.134)	0.369 (6.22)
Book Value of Total Assets (Log $ Millions)	0.015 (0.433)	0.015 (0.435)	0.016 (0.438)	0.016 (0.444)	0.017 (0.456)	0.023 (0.550)	0.007 (0.52)
Δ Beta	−0.331 (−2.139)	−0.340 (−2.131)	−0.345 (−2.131)	−0.354 (−2.131)	−0.363 (−2.108)	−0.381 (−2.145)	−0.118 (−2.46)
Δ Residual Standard Dev. Returns (percent)	0.306 (4.660)	0.313 (4.572)	0.317 (4.508)	0.324 (4.377)	0.332 (4.196)	0.347 (3.582)	0.100 (3.93)
Δ (Receivables/Total Assets)	−0.239 (−1.488)	−0.255 (−1.549)	−0.262 (−1.572)	−0.285 (−1.661)	−0.317 (−1.785)	−0.479 (−2.186)	−0.124 (−1.63)
Δ (Inventory/Total Assets)	0.406 (3.138)	0.419 (3.132)	0.424 (3.111)	0.438 (3.078)	0.455 (3.011)	0.511 (2.460)	0.153 1.86
Δ (Total Liabilities/Total Assets)	1.786 (2.192)	1.785 (2.142)	1.782 (2.113)	1.765 (2.032)	1.733 (1.916)	1.538 (1.498)	0.389 (1.62)
Pseudo-R^2[c]	.178	.185	.189	.195	.201	.202	0.230[e]
χ^2-Statistic on log likelihood ratio[d]	24.355	34.105	40.289	55.137	77.253	152.152	19.83[f]
P-Value	0.007	0.000	0.000	0.000	0.000	0.000	0.000

[a] Prior probability incorporated in results in the paper.

[b] Prior probability without *WESML* is the proportion of observations in the estimation sample which is 0.38652 (218/564).

[c] The pseudo-R^2 is equal to one less the ratio of the log likelihood at convergence for the *WESML* probit (unconstrained) to the log likelihood with only the constant term in the model (constrained).

[d] Minus two times the difference in the log likelihood of the unconstrained and constrained models is distributed asymptotically χ^2, with degrees of freedom equal to the difference in the number of the parameters of the two models.

[e] Adjusted R^2 of regression.

[f] *F*-statistic of regression.

of the proportion of type I and type II errors, and the cost of the model relative to a naive benchmark.[29] For the *WESML* models, the prior probabilities in the misclassification cost calculations are the same as those used to estimate

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[29] The naive benchmark classifies all firms as clean, or all firms as qualified, depending on which expected cost is lower. The first naive strategy has lower cost if the relative costs of type I and type II errors are less than $(1/\alpha_p)$. The second naive strategy has lower cost if the relative costs of type I and type II errors are greater than $(1/\alpha_p)$.

TABLE A3
ESTIMATED PROBABILITIES AND MISCLASSIFICATION COSTS FOR VARIOUS ESTIMATES OF PRIOR PROBABILITY
(ESTIMATION SAMPLE: 218 QUALIFIED, 346 CLEAN)

	Prior Probabilities for WESML *Probit Estimate*					*Probit*[b] *Without* WESML	*OLS*[c]
	.02622	*.03859*	*.04697*[a]	*.06892*	*.10718*		
Panel A: Estimated Probabilities							
Mean: Qualified	.1472	.1825	.2023	.2453	.3020	.5415	.5360
Clean	.0231	.0332	.0398	.0568	.0853	.2921	.2923
t-Statistic for difference	9.657	10.009	10.185	10.523	10.908	11.926	11.629
P-Value	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Median: Qualified	.0398	.0578	.0697	.1000	.1498	.4537	.4367
Clean	.0141	.0214	.0266	.0398	.0630	.2677	.2796
χ^2-Statistic for difference	62.977	62.977	62.977	65.752	68.587	65.752	34.345
P-Value	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Panel B: Misclassification Costs							
1:1 Relative Costs: Cutoff	.2699	.3444	.3860	.4738	.5808	.8636	.8098
Probability of type I	.766	.766	.761	.752	.752	.748	.743
Probability of type II	.000	.000	.000	.000	.000	.000	.000
Error cost relative to naive[d]	.766	.766	.761	.752	.752	.748	.743
5:1 Relative Costs: Cutoff	.2699	.3126	.2175	.2833	.1292	.7308	.8089
Probability of type I	.766	.729	.674	.674	.436	.674	.743
Probability of type II	.000	.006	.017	.017	.136	.017	.000
Error cost relative to naive[d]	.766	.758	.745	.721	.662	.745	.743
10:1 Relative Costs: Cutoff	.1415	.1225	.1098	.0828	.1021	.6386	.4980
Probability of type I	.674	.628	.569	.431	.367	.633	.555
Probability of type II	.017	.035	.061	.139	.211	.029	.066
Error cost relative to naive[d]	.739	.715	.692	.619	.652	.692	.690
20:1 Relative Costs: Cutoff	.0541	.0477	.0571	.0619	.0251	.4170	.3887
Probability of type I	.546	.440	.431	.339	.023	.436	.395
Probability of type II	.072	.133	.136	.243	.867	.145	.171
Error cost relative to naive[d]	.680	.606	.569	.745	.922	.582	.568

[a] Prior probability incorporated in results in the paper.

[b] Prior probability without *WESML* is the proportion of observations in the estimation sample which is 0.38652 (218/564). Misclassification costs are based on prior probability of qualified opinion of .04697.

[c] Misclassification costs are based on prior probability of qualified opinion of .04697.

[d] The naive strategy involves either classifying all firms as qualified or all firms as clean, whichever strategy has the lowest expected cost. The first naive strategy has lower expected costs if the relative costs of type I and type II errors are less than $1/\alpha_p$.

the model. For the OLS and unweighted probit models, α_p is set equal to 0.04697 to determine the sensitivity of the results to the estimation procedure.

Inferences about the performance of the model are not sensitive to the particular choice of α_p within the range reported in the table. Similar effects are observed if the models are applied to the holdout sample, although the variability is higher due to the smaller size of the holdout sample. Interestingly, for purposes of prediction, not parameter inference, the unweighted probit and OLS results are almost equivalent to the *WESML* results.

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Simulation Evidence and Analysis of Alternative Methods of Evaluating Dollar-Unit Samples

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ABSTRACT: Several new methods of evaluating dollar-unit samples have been proposed recently for use in auditing. This paper presents results of a simulation study that compared four of these new methods. Additional simulations on alternative forms of two of these are also presented. Evidence on the reliability and relative size of the upper error bounds for each method is provided for 2,160 different combinations of sample sizes, confidence levels, and types of accounting populations. The results provide a comprehensive analysis of the capabilities of these methods. All four methods have strengths and weaknesses. The Multinomial Dirichlet bound is quite reliable but very conservative and (as formulated) not able to utilize understatement errors. The two versions of the Cox and Snell bound that were tested (with different priors) varied considerably in their reliability over a range of confidence levels. While not without an occasional reliability problem, test results for the Moment Method bound and one of the two Bayesian-Normal bounds were largely favorable.

The accounting literature has recently included a number of audit sampling papers reporting on a new method for evaluating a dollar-unit sample of an accounting population. In each case the authors have chosen to compare the proposed method with the commonly used Stringer method of dollar-unit sampling (DUS). Since these new methods were largely developed concurrently, different test populations and simulation criteria were used in each paper to evaluate the performance and confidence level reliability of the proposed method. In addition, the simulation results provided in each paper were only based upon a limited set of conditions. As a result of these factors, auditors and researchers are not able to effectively compare these new methods of evaluating dollar-unit samples.

This paper presents results of a simulation study that has compared four of these new DUS methods over a wide variety of conditions. Over one million

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separate upper confidence bounds[1] were computed for each method. Since the four methods provide alternative ways of determining these upper confidence bounds on the total error in an accounting population, it is of interest to consider their relative effectiveness (in providing a bound that is greater than the actual error) and efficiency (in providing as small a bound as possible).

Our simulation study examined the Bayesian Normal bound [Menzefricke and Smieliauskas 1984], the Cox and Snell bound [Godfrey and Neter, 1984; Neter and Godfrey, 1985], the Modified Moment bound [Dworin and Grimlund, 1984, 1986], and the Multinomial Dirichlet bound [Tsui, Matsumura, and Tsui, 1985].[2] The four methods differ significantly with respect to the type of sample information that can be used. The Bayesian Normal (BN) and Modified Moment (MM) methods are able to utilize both the overstatement (OS) errors and any understatement (US) errors of the sample. In contrast, the Cox and Snell (CS) and Multinomial Dirichlet (MD) methods can only use the OS errors of the sample.[3] This is a limitation to the use of CS and MD methods, especially for audits of inventory populations when significant US errors are expected.

Many of the simulation analyses in this paper are based upon accounting populations with significant levels of US errors. We considered excluding the CS and MD methods from these analyses. However, even in circumstances where auditors are primarily concerned with (or mainly anticipate) OS errors, US errors can arise to varying degrees. Consequently, it is important to be able to observe the comparative performance of all four methods under these circumstances. It will be seen from the simulation results that the CS and MD methods can perform quite differently when US errors are not used and that the CS method is not uniformly "reliable" under such circumstances.

We have measured the reliability of the various methods by considering their repeated sampling performance. For example, a simulation study at the 80 percent "nominal" confidence level (CL) should find that exactly 80 percent of the calculated overstatement confidence bounds of the simulation trials were greater than (i.e., cover) the actual error in the population. If the simulated "coverage" is considerably lower than 80 percent, then the method would usually be viewed as being quite unreliable when used with the particular population.[4] Similarly, coverage much more frequent than the 80 percent target indicates a conservative method.

The BN, CS, and MD methods have all been constructed using Bayesian procedures, whereas the MM method is based upon a classical approach to statistical inference. The three Bayesian methods are evaluated in this paper from a non-Bayesian perspective with fixed prior judgments that have been determined by the developers of the various methods. Indeed, in each case simulation results were previously used by the authors to "fine-tune" their method and determine one or more possible "prior judgments." These priors are intended to provide a bound with reliable confidence levels (CLs) over a large variety of populations.[5]

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[1] Technically speaking, the Bayesian bounds are credibility bounds rather than confidence bounds. However, as an expository aid we will use the term "confidence bound" throughout this paper.

[2] Our study has not included the quasi-Bayesian bound [McCray, 1984]. Including this bound would have duplicated (to a some extent) a previous comparison of the quasi-Bayesian bound with the Modified Moment bound [Dworin and Grimlund, 1986]. In addition, because of the intensive computations of the quasi-Bayesian bound, it was not feasible to include it.

[3] It is, of course, possible to do a "mirror image" type analysis and use these two methods with only understatement errors. As these two methods are now formulated, both over- and understatement errors cannot be included in the same analysis. However, the logic of the MD method might be modified so that it would also consider a range of US taintings.

[4] The point at which one decides that a particular method is unreliable is a subjective matter. The role of other audit procedures is, of course, an important factor. In our experience, auditors have a wide variety of viewpoints as to what may or may not be considered a reliable set of circumstances when the simulated coverage is around or greater than the nominal confidence level.

The simulation results in the main part of the paper are based on the BN prior of Menzefricke and Smieliauskas [1984], the "CS10" prior of Godfrey and Neter [1984], and the "B3" prior of Tsui, Matsumura, and Tsui [1985]. The choice of these three priors was based upon reported evidence on their reliability for typical accounting populations. Comparable simulation results are also provided in the Appendix for two other priors: an alternative "N2" (Bayesian Normal) prior used by Smieliauskas [1986] and an alternative "CS11" prior considered by Neter and Godfrey [1985]. Our interest in the performance of the two methods with these alternative priors is motivated by the emphasis that the respective authors have given these priors.

In both cases the alternative priors were found to have less reliable CLs for populations for which ten percent to 40 percent of all the error amounts were 100 percent OS taintings.[6] However, the alternative priors performed more favorably in unusual situations [Johnson et al., 1981] where 66 percent to 100 percent of the errors were 100 percent OS taintings. Consequently, the main part of the paper focuses on the particular priors for the three Bayesian methods that lead to the more reliable bounds over the more common circumstances.

The scope of analysis in this paper is much more extensive than that of a recent survey of new methods provided by Smieliauskas [1986]. A much wider range of sample sizes, types of populations, and nominal CLs has been considered. Simulation results are provided for CLs ranging from 95 percent to 50 percent (rather than just 95 percent) and sample sizes ranging from 60 to 240 (rather than primarily 100). Finally, by considering a wide range of accounting error populations (164 different types), it has been found that the CL used and the size of error taintings have a crucial bearing on the reliability of several of the methods studied.

The next section provides a brief summary of the four methods. It is followed by a discussion of the design of the simulation study. The last section before the Conclusions presents the results of the simulations and an analysis of their implications for audit practice.

SUMMARY OF THE FOUR METHODS OF EVALUATING DOLLAR-UNIT SAMPLES

While the mathematical details of the four methods are quite different, there is a considerable amount of commonality in the general nature of the mathematics used. In particular, some combination of three general approaches has been used in developing each method. These are: (1) mathematical decomposition of errors into error occurrence rate and error tainting components; (2) one or

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[5] Tsui, Matsumura, and Tsui [1985] also investigated two specialized prior distributions for their Multinomial Dirichlet approach. These priors might be used by an auditor to incorporate specific Bayesian prior judgments. They were not considered in the present study since they were not developed by the authors as part of a general-purpose confidence bound. Indeed, the Tsui et al. data indicate that these specialized priors will not lead to confidence bounds with acceptable levels of coverage over a large variety of situations.

[6] A dollar-unit tainting is the percentage error in the book value balance being examined. For example, if the book value is $100 and the audit value is $60, then each of the 100 dollar units of the book value balance has a .40 (or 40 percent) tainting error. Consequently, a 100 percent OS tainting occurs when the audit value is zero.

TABLE 1

MATHEMATICAL STRUCTURE OF THE FOUR METHODS OF EVALUATING DOLLAR-UNIT SAMPLES

Method	*MDE*	*BNC*	*MMA*	*Distribution Used for Calculations*
Bayesian Normal	x	x	x	*t*-distribution
Cox and Snell	x	x		*F*-distribution
Modified Moment	x		x	Gamma distribution
Multinomial Dirichlet		x	x	Beta distribution

MDE = Mathematical Decomposition of Errors into Rates and Taintings
BNC = Bayesian Natural Conjugate Prior to Posterior Analysis
MMA = Mathematical Approximation for the Resulting Sampling Distribution by Matching Theoretical Moments

more Bayesian natural conjugate relationships; and (3) a mathematical approximation for the resulting sampling distribution by matching theoretical moments (the mean, variance, and possibly the skewness). Table 1 classifies the four methods along these three dimensions.

The *Bayesian Normal* (*BN*) *bound* of Menzefricke and Smieliauskas [1984] is based upon a mathematical modification of a Bayesian Beta-Normal sampling model developed by Felix and Grimlund [1977]. In addition, Menzefricke and Smieliauskas applied the Felix and Grimlund model to dollar units (rather than to individual accounts) and approximated the resulting distribution using a *t*-distribution (rather than a gamma distribution). The reported performance provided by Menzefricke and Smieliauskas for the BN bound was primarily based upon simulation analyses at the 95 percent CL with a sample size of 120.

The *Cox and Snell* (*CS*) *bound* of Godfrey and Neter [1984] and Neter and Godfrey [1985] is based upon a Bayesian sampling model developed by Cox and Snell [1979]. In their two papers, Godfrey and Neter examined the effectiveness of this model using several investigated approaches and a variety of priors. The simulation results in the main part of the paper are based on Godfrey and Neter's "CS10" prior for the Cox and Snell model.[7] As an expository aid, the label "CS" has been used for this prior rather than Godfrey and Neter's "CS10" label. From their data, it appears that the CS10 prior (with a relatively high mean error tainting) leads to a more conservative bound than the bounds resulting from any of the other priors that Godfrey and Neter included in their papers. The CS bound cannot utilize both OS and US errors in the same analysis. For example, any US errors in a sample of accounts receivable would be ignored. The reported performance provided by Godfrey and Neter for the CS bound was based on simulation analyses at the 95 percent CL with a sample size of 100.

The *Modified Moment* (*MM*) *bound* of Dworin and Grimlund [1984, 1986] combines probability moments from separate sampling distributions for possible error occurrence rates and for possible error amounts. The most distinctive feature of their method is the use of an extra hypothetical sample error (i.e., their t^* tainting) whose magnitude is determined by the size and frequency of errors actually occurring in the sample. The reported performance provided by Dworin and Grimlund for the MM bound was based upon simulation analyses at the 95 percent CL with a sample size of 100.

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[7] This is not the same Cox and Snell bound as that studied by Smieliauskas [1986]. He used a diffuse prior with the original Cox and Snell mathematics and did not directly consider the Godfrey and Neter analysis.

The *Multinomial Dirichlet* (*MD*) *bound* of Tsui, Matsumura, and Tsui [1985] is a Bayesian version of the multinomial DUS bound developed by Fienberg et al. [1977], Neter et al. [1978], and Leitch et al. [1982]. However, the analysis and final procedure of Tsui et al. are completely different from the earlier work. Tsui et al. use a beta probability distribution for approximating the posterior distribution of the proportion of book value in error. The resulting bound is relatively easy to calculate with a computer, especially when compared to the calculations that can arise when using the multinomial bound. The general purpose "B3 prior" provided by Tsui et al. has been used in the current study. These authors state (p. 87) that it is a relatively strong prior that "places a higher prior mean on the proportion of 100 percent taintings" (i.e., relative to their other priors). The formulation of the MD bound provided by Tsui et al. cannot utilize both OS and US errors in the same analysis. The reported performance by Tsui et al. for the MD bound was based on simulation analyses at the 90, 95, and 99 percent CLs and with sample sizes of 100 and 200.

SIMULATION DESIGN

The simulated populations of accounting errors that were used to test the four methods were constructed using the structure and methods developed by Leitch et al. [1982] and Dworin and Grimlund [1984, 1986]. Figure 1 of Dworin and Grimlund [1984] provides an illustration of one such simulated accounting error distribution. In particular, each accounting error distribution was visualized as having a fixed dollar error occurrence rate and a component distribution of the dollar error taintings for those dollars that were in error. This dollar error tainting distribution was formed from a mixture or weighted average of three components: (1) a χ^2 distribution for US error taintings, (2) a separate χ^2 distribution for OS error taintings (but not 100 percent OS taintings), and (3) a separate category of 100 percent OS taintings. The χ^2 distributions for overstatement errors were truncated at 1.00 so that simulated values of these errors would not exceed 100 percent of book value (US error taintings were not truncated).

To test the four methods over a wide variety of situations, 2,160 different combinations of parameter values were used. In each case a simulation was conducted using 500 trials. In total, the results presented in this paper are based upon 6,480,000 separate confidence bound calculations. The tests were formed using *all of the possible combinations* of parameter values shown in Table 2. These tests were divided between those directed at accounts receivable-type populations and those directed at inventory-type populations. In each case, 1,080 separate simulations were conducted using various combinations of sample size, confidence level, monetary error occurrence rate, error tainting model, weight to the US error tainting distribution, and weight to 100 percent OS taintings.

Table 2 also discusses three "error models," denoted by M1, M2, and M3, that were used for these tests. Each error model was based upon a unique combination of two scaled χ^2 distributions that were used to generate, respectively, the OS and US error taintings. The three models provided, respectively, mean OS

TABLE 2
PARAMETERS OF THE SIMULATION MODELS

	Sample Sizes	*Confid. Levels*	*Error Rates*	*Error Taintings* *Models*	*Percent Under*	*Percent 100*	*Residual Percent Over*
Receivable Populations	60	95%	3%	M1	0	0	100
	120	90	6	M3	10	10	to
	240	80	10		20	20	40
		70				40	
		50					
Inventory Populations	60	95%	10%	M1	20	0	80
	120	90	30	M2	50	10	to
	240	80	60		70	20	0
		70				30	
		50					

The Error Rates give the frequency of occurrence of errors. The remaining columns define the magnitude of the possible error taintings that occur when there is an error. Each Error Tainting Model is a mixture of scaled χ^2 distributions for understatement (US) and overstatement (OS) errors. The mean errors of these two distributions are given in the following chart.

Model	*US Mean*	*OS Mean*
M1	.1	.1
M2	.2	.2
M3	.1	.3

The Percent Under, Percent Over, and Percent 100 values of the table give the relative weight assigned to these two distributions and to 100 percent OS errors (which always have a 1.00 tainting).

error taintings (before truncating—as previously discussed) of .10, .20, and .30; and, respectively, mean US error taintings of .10, .20, and .10. A more complete description of these models can be found in Table 5 of Dworin and Grimlund [1984]. The χ^2 models chosen are reasonably representative of the empirical distributions for accounts receivable and inventory errors that have been reported [e.g., Neter et al., 1985].

As seen in Table 2, we varied the weights attached to the three error tainting components of the tests. For example, one of the many combinations that was used assigned a 20 percent weight to the US error tainting distribution and a ten percent weight to 100 percent OS taintings. The remaining "residual weight" of 70 percent was then assigned to the OS tainting distribution. In summary, the error taintings for any particular simulation study were controlled at three levels. First an *error occurrence rate* was used to control the frequency of a tainting error. Second, *percentage weights* were used to control the proportions of the three types of taintings. Third, χ^2 distributions of the *error tainting models* (e.g., M2) were used to control the magnitude of the US and OS error taintings.

Table 2 also shows the selection of sample sizes and CLs for the tests. The sample sizes ranged from 60 to 240 and the CLs ranged from 50 percent to 95 percent. While some combinations, like 240 and 50 percent, are of limited interest, it was much more straightforward to include them than to deal with special cases. Note that CLs as low as 50 percent have been used. It is our understanding that many auditors routinely use DUS confidence levels that are substantially lower than 95 percent since they are developing their overall confidence using several additional sources of evidence.

The choice of parameters for defining the error distributions of the tests is somewhat broader than the types of error distributions used by Dworin and Grimlund [1984, 1986]. In particular, the error distributions cover (1) the common range of situations found in available empirical studies [e.g., Johnson et al., 1981; Neter et al., 1985; Ramage et al., 1979]; and (2) more extreme situations such as a 40 percent weight for 100 percent OS taintings. While 40 percent is a high proportion of taintings that are 100 percent OS errors, the accompanying error occurrence rate could be low, e.g., ten percent. In this case there would be a four percent rate of 100 percent OS errors in the population. Thus, the objective of the study was to gain evidence on how the four methods performed with both documented types of error patterns and with more extreme situations. The latter are certainly possible but probably not frequently encountered.

SIMULATION RESULTS

The analysis and discussion of the simulations has been organized using two levels of display: detailed tables and aggregate tables. The detailed tables showing the population-by-population results are discussed first. This is followed by a discussion of the aggregate tables showing average results for similar groups of populations.

Detailed Simulation Results

Tables 3 to 5 illustrate the type of comparative information that has been developed on a population-by-population basis. As will be discussed, the tables show the "coverages," "Stringer-based advantages," and "average bounds" of the four methods. These three tables are samples from a series of 60 detailed tables (available from the authors at nominal duplicating cost). The detailed tables provide the simulation results for all combinations of parameter values shown in Table 2. Each of the 60 tables shows simulation results for one model (i.e., M1, M2, or M3) of the two broad classes of populations (either accounts receivable-type or inventory-type populations) and is for a particular CL.

From the many possibilities, tables for the 95 percent CL have been selected for inclusion in the paper. While the choice is somewhat arbitrary, the 95 percent CL is quite important and commonly referred to in both the academic and practice-oriented literature. While not all the relations in our data are evident from an analysis of these tables for the 95 percent CL, they do illustrate several of the main effects.

Coverages. Each coverage statistic, as illustrated in Table 3, shows the percentage of the 500 trials for the particular simulation for which the calculation bound was greater than the actual error of the population. These actual errors are expressed as a percentage of book value and are shown in the fourth column on the left side of the table. One is especially concerned about "simulated" coverage percentages that are considerably lower than the "nominal" 95 percent CL shown at the top of the table.

Table 3 also shows 36 of the 72 different accounts receivable-type accounting error populations that were used in the

TABLE 3

COMPARISON OF THE CONFIDENCE LEVEL COVERAGES OF THE FOUR NEW METHODS
EACH VALUE GIVES A PERCENTAGE OF 500 SIMULATIONS THAT HAD AN UPPER CONFIDENCE BOUND THAT WAS LARGER THAN THE ACTUAL ERROR IN THE POPULATION

Accounts Receivable								*95 Percent Confidence Level*							*Model 3*
				Sample Size											
				60				*120*				*240*			
Over Percent	*Under Percent*	*100 Percent*	*Actual Error*	*CS*	*BN*	*MD*	*MM*	*CS*	*BN*	*MD*	*MM*	*CS*	*BN*	*MD*	*MM*
Three Percent Error Occurrence Rate															
100	0	0	0.90	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	99.2	98.2	100.0	98.0
90	10	0	0.78	100.0	100.0	100.0	100.0	100.0	100.0	100.0	99.4	99.4	99.4	100.0	99.4
80	20	0	0.66	100.0	100.0	100.0	100.0	100.0	100.0	100.0	99.8	99.8	99.6	100.0	100.0
90	0	10	1.11	100.0	100.0	100.0	100.0	98.0	100.0	100.0	100.0	98.4	96.2	99.2	93.4
80	10	10	0.99	100.0	100.0	100.0	99.8	100.0	100.0	100.0	99.4	98.0	97.8	99.8	96.8
70	20	10	0.87	100.0	100.0	100.0	100.0	100.0	100.0	100.0	99.4	97.8	98.6	100.0	97.8
80	0	20	1.32	100.0	100.0	100.0	100.0	98.0	91.0	100.0	97.2	96.6	93.8	97.8	94.2
70	10	20	1.20	100.0	100.0	100.0	99.6	97.4	95.4	100.0	99.4	96.4	94.8	97.8	95.0
60	20	20	1.08	100.0	100.0	100.0	99.4	95.8	100.0	100.0	98.2	97.4	96.4	98.6	95.8
60	0	40	1.74	100.0	100.0	100.0	100.0	92.0	83.6	100.0	92.0	91.8	87.6	95.4	94.0
50	10	40	1.62	100.0	100.0	100.0	100.0	92.2	88.8	100.0	94.0	91.6	89.8	96.6	93.8
40	20	40	1.50	100.0	100.0	100.0	98.0	91.6	88.8	100.0	94.2	91.0	91.4	95.8	95.0
Six Percent Error Occurrence Rate															
100	0	0	1.80	100.0	100.0	100.0	100.0	98.8	98.0	100.0	96.8	98.4	97.4	97.6	97.0
90	10	0	1.56	100.0	100.0	100.0	99.4	99.8	99.6	100.0	98.6	99.0	98.8	99.6	97.8
80	20	0	1.32	100.0	100.0	100.0	99.4	99.8	99.6	100.0	99.4	99.6	99.0	100.0	99.0
90	0	10	2.22	97.6	100.0	100.0	100.0	97.4	94.6	98.8	94.4	97.8	96.0	97.6	97.0
80	10	10	1.98	96.0	100.0	100.0	99.6	97.4	96.8	99.8	94.8	97.0	95.8	96.4	95.0
70	20	10	1.74	100.0	100.0	100.0	98.0	98.0	98.2	100.0	96.8	97.8	96.4	97.8	95.2
80	0	20	2.64	95.6	88.8	100.0	97.0	94.0	92.0	96.2	92.4	93.2	91.2	94.6	94.6
70	10	20	2.40	96.8	93.8	100.0	98.6	94.4	93.0	96.4	92.6	96.0	93.0	97.2	95.8
60	20	20	2.16	95.0	100.0	100.0	97.8	94.6	95.4	98.2	94.6	95.8	94.8	96.8	94.6
60	0	40	3.48	89.0	82.8	100.0	90.8	88.6	86.8	95.0	93.2	93.0	91.8	94.2	95.6
50	10	40	3.24	88.2	84.6	100.0	91.4	88.8	89.6	95.8	93.0	92.4	92.2	94.2	94.6
40	20	40	3.00	88.4	86.6	100.0	93.6	88.0	89.4	94.8	93.2	92.8	92.2	95.4	94.8
Ten Percent Error Occurrence Rate															
100	0	0	3.00	99.2	98.6	100.0	98.0	98.2	97.4	98.2	94.0	97.6	96.0	96.6	96.8
90	10	0	2.60	99.6	98.6	100.0	100.0	98.8	98.6	99.2	98.2	98.6	96.2	97.6	95.8
80	20	0	2.20	99.2	100.0	100.0	99.8	99.4	99.4	99.8	99.6	99.2	97.4	98.2	96.2
90	0	10	3.70	95.8	94.6	99.6	93.4	93.6	92.6	94.6	93.4	94.8	92.4	94.0	95.0
80	10	10	3.30	96.8	97.8	100.0	96.8	96.6	95.6	97.2	95.0	96.6	94.8	96.8	95.8
70	20	10	2.90	96.8	98.6	100.0	97.2	96.8	96.6	98.0	95.2	97.8	96.4	97.8	96.2
80	0	20	4.40	91.2	90.6	97.6	90.0	92.6	90.6	94.4	93.8	92.2	90.6	92.8	95.4
70	10	20	4.00	91.6	92.6	98.6	90.8	93.2	93.6	95.4	94.4	94.4	92.2	95.0	95.2
60	20	20	3.60	92.4	94.6	100.0	94.2	94.8	94.6	96.4	93.4	94.0	92.8	95.8	94.4
60	0	40	5.80	83.8	84.0	92.6	91.0	88.6	87.8	93.8	94.6	91.4	90.2	93.2	95.8
50	10	40	5.40	85.0	86.0	93.2	91.2	89.4	89.8	94.6	94.4	93.2	90.6	94.8	95.4
40	20	40	5.00	85.2	88.0	94.2	91.4	91.6	92.2	95.8	94.6	94.2	91.0	95.6	95.4
Average Values:				96.2	96.1	99.3	97.1	95.5	94.7	98.1	95.9	96.0	94.5	97.0	95.9

simulations. These 36 populations were based upon error model 3 (as defined in Table 2). The other 36 accounts receivable populations were based upon error model 1 (also defined in Table 2). Note also that the left side of Table 3 shows the various combinations of OS, US, and 100 percent OS taintings that were used with the accounts receivable populations (for both models 1 and 3). In particular, the level of 100 percent OS taintings ranged from zero to 40 percent of all error taintings. Similarly, the weight assigned to the US error tainting distributions ranged from zero to 20 percent.

Note that many of the coverages shown in Table 3 tend to fall below the nominal 95 percent CL value when a high percentage of the error amounts (e.g., 20 percent and 40 percent) are 100 percent OS taintings. This effect is particularly apparent at larger error occurrence rates and smaller sample sizes, especially for the CS method. In contrast, the MD method is largely unaffected by these factors. It is, in general, a very conservative method. The coverages of all of the methods move (to varying degrees) toward the nominal 95 percent CL as the sample size increases. This effect is particularly apparent with the MM method and has been observed at other CLs as well.

The high coverages shown in the upper left corner of the table (i.e., 100.0) are not always representative of the performance of the BN and CS methods at lower CLs. In particular, it is seen that the BN and CS methods have coverages that are 5.0 above nominal (i.e., 100.0 −95) with a sample size of 60, a three percent error occurrence rate, and a 40 percent level of 100 percent OS error taintings. For the same situation, but at the 70 percent CL, the average coverage of the two methods is respectively 13.2 and 13.6 below the nominal 70.0 value. Further evidence of this effect can be seen in the aggregate tables which will follow.

Advantage Over SO. Each advantage statistic, as illustrated in Table 4, provides the percentage reduction in the average upper confidence bound that was achieved with a particular DUS method. Each of these percentage reductions was based on 500 individual simulation trials and was measured with respect to the "Stringer offset" (SO) method of Leslie, Teitlebaum, and Anderson (LTA) [1979, p. 129] rather than the Meikle [1972] form of the Stringer bound (which also uses understatements).[8] While the LTA SO method has only limited use in practice, it is an easily implemented and reliable enhancement to the standard Stringer method that more effectively uses understatements than the Meikle method [Grimlund and Schroeder, 1987].[9] As such, it provides a more challenging standard of comparison than the Meikle form of the Stringer bound for the methods investigated in this paper.

To facilitate comparisons, the coverages of Table 3 and the advantages of Table 4 are both for the same simulations (i.e., accounts receivable with model 3). In examining the advantages of Table 4 one must also consider the accompanying coverages of Table 3. High advantages without appropriate reliability (as seen from the coverages) are not particularly useful. For example, the advantages of the BN and CS methods are fairly uniform for all simulations using a particular sample size and error occurrence rate. Within each such group

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[8] The LTA SO method reduces the initial Stringer bound (which did not utilize understatements) by the average US error (i.e., the sum of the US tainting divided by the sample size). This LTA SO procedure is used in this paper. It should not be confused with LTA's offset procedure for their DUS-cell method of evaluating sample results (p. 144). The DUS-cell method uses a different sample selection procedure than all the methods that we tested. Consequently, our comparisons were based on the LTA Stringer offset method. This allows us to hold the sample selection procedure constant and concentrate on the various ways in which a bound might be calculated for the same sampling results.

[9] This study found the LTA SO method to be consistently and unequivocally reliable over a wide variety of conditions. In addition, it always provided a tighter upper confidence bound than that provided by the Meikle approach.

TABLE 4

COMPARISON OF THE ADVANTAGES OF THE FOUR NEW METHODS OVER THE STRINGER OFFSET
EACH VALUE GIVES A PERCENTAGE REDUCTION IN THE AVERAGE CONFIDENCE BOUND
(RELATIVE TO THE STRINGER OFFSET) THAT WAS ACHIEVED
WITH THE NEW DUS METHOD

Accounts Receivable				*95 Percent Confidence Level*											*Model 3*
				Sample Size											
				60				*120*				*240*			
Over Percent	*Under Percent*	*100 Percent*	*Actual Error*	*CS*	*BN*	*MD*	*MM*	*CS*	*BN*	*MD*	*MM*	*CS*	*BN*	*MD*	*MM*
Three Percent Error Occurrence Rate															
100	0	0	0.90	44.9	47.6	26.7	36.5	31.5	37.1	22.2	32.5	20.1	26.8	18.2	22.3
90	10	0	0.78	45.8	46.8	26.4	35.8	32.1	36.2	21.8	32.9	20.2	25.9	17.5	23.8
80	20	0	0.66	46.7	45.9	25.9	34.9	33.0	35.2	21.2	32.7	20.6	25.0	16.7	24.6
90	0	10	1.11	44.9	47.3	25.1	32.1	31.7	36.7	19.9	27.1	20.4	26.0	15.3	16.7
80	10	10	0.99	45.9	46.6	24.7	31.9	32.5	35.8	19.3	27.4	20.7	25.1	14.3	17.5
70	20	10	0.87	46.9	45.9	24.3	31.8	33.5	34.7	18.7	27.7	21.2	24.1	13.4	18.5
80	0	20	1.32	44.9	47.4	23.6	28.5	31.6	36.4	17.8	21.9	20.3	25.5	12.8	11.6
70	10	20	1.20	45.9	46.8	23.3	28.4	32.5	35.4	17.2	22.0	20.7	24.6	11.8	12.5
60	20	20	1.08	46.9	45.6	22.8	28.0	33.6	34.3	16.4	22.8	21.2	23.6	10.8	13.4
60	0	40	1.74	44.8	47.5	21.1	21.6	31.3	36.0	14.5	13.8	19.5	24.7	9.7	5.0
50	10	40	1.62	45.6	46.8	20.7	21.5	32.1	35.3	14.0	14.0	19.9	23.9	8.8	5.7
40	20	40	1.50	46.4	45.9	20.3	21.7	33.0	34.4	13.2	14.6	20.5	23.2	7.8	6.2
Six Percent Error Occurrence Rate															
100	0	0	1.80	37.0	39.0	26.0	34.5	23.4	27.8	20.4	23.8	14.0	19.7	15.4	14.5
90	10	0	1.56	37.8	37.7	25.5	34.8	23.6	26.9	19.7	25.2	13.3	19.1	14.3	16.1
80	20	0	1.32	38.7	36.8	25.0	34.8	23.8	25.9	19.1	26.2	12.4	18.3	13.2	17.6
90	0	10	2.22	37.2	38.7	23.7	29.1	23.8	27.1	17.5	18.2	14.3	18.6	12.6	9.9
80	10	10	1.98	38.0	37.8	23.2	29.2	23.9	26.2	16.8	19.1	13.8	17.9	11.5	11.0
70	20	10	1.74	39.0	36.5	22.5	29.7	24.4	25.1	15.8	20.0	13.2	17.2	9.9	12.0
80	0	20	2.64	37.3	38.6	21.9	24.6	23.7	26.6	15.5	14.1	13.9	17.7	10.6	6.5
70	10	20	2.40	38.2	37.5	21.3	24.8	24.1	25.6	14.6	15.0	13.5	17.1	9.3	7.3
60	20	20	2.16	39.2	36.6	20.6	25.2	24.6	24.7	13.5	15.7	13.0	16.4	7.8	8.2
60	0	40	3.48	37.1	38.1	18.9	16.8	23.0	25.7	12.3	7.2	12.4	16.6	7.8	1.3
50	10	40	3.24	37.7	37.3	18.3	17.0	23.4	25.0	11.4	7.8	12.1	16.0	6.7	1.8
40	20	40	3.00	38.7	36.4	17.6	17.7	24.0	24.2	10.5	8.3	11.7	15.3	5.3	2.3
Ten Percent Error Occurrence Rate															
100	0	0	3.00	31.0	31.5	24.9	28.9	18.6	22.2	18.6	18.1	11.0	15.6	13.1	10.8
90	10	0	2.60	31.4	30.7	24.3	29.7	18.1	21.5	17.6	19.7	9.5	15.2	11.6	12.3
80	20	0	2.20	31.9	29.6	23.5	30.0	17.6	20.6	16.4	20.6	7.9	14.7	9.9	13.6
90	0	10	3.70	31.3	30.9	22.2	23.0	18.9	21.2	15.7	13.0	11.2	14.4	10.7	7.1
80	10	10	3.30	31.7	30.0	21.5	23.7	18.6	20.5	14.6	14.0	10.1	14.0	9.2	8.0
70	20	10	2.90	32.2	28.9	20.7	24.4	18.3	19.5	13.2	15.0	8.8	13.4	7.3	8.9
80	0	20	4.40	31.2	30.5	20.1	18.3	18.6	20.4	13.7	9.3	10.5	13.5	9.0	4.3
70	10	20	4.00	31.7	29.6	19.4	19.2	18.3	19.7	12.4	10.1	9.5	13.0	7.5	5.0
60	20	20	3.60	32.4	28.5	18.3	19.4	18.2	18.8	11.0	10.9	8.3	12.4	5.7	5.6
60	0	40	5.80	30.6	29.9	17.2	11.6	17.3	19.4	10.8	3.8	8.6	12.2	6.8	0.4
50	10	40	5.40	31.2	29.1	16.5	11.9	17.1	18.7	9.8	4.2	7.8	11.8	5.6	0.7
40	20	40	5.00	31.9	28.2	15.5	12.4	17.1	18.0	8.6	4.6	6.8	11.2	4.1	1.0
Average Values:				38.4	38.0	22.0	25.6	24.7	27.2	15.7	17.6	14.2	18.6	10.6	10.1

of simulations, the high advantages for high levels of 100 percent OS taintings (i.e., towards the bottom of each subcolumn) correspond to situations where the coverage of the BN and CS methods tends to be rather low.

Note that the accounts receivable advantages are quite small in the bottom right section of Table 4 where there is a ten percent error occurrence rate and a sample size of 240. This effect is also present at other CLs and illustrates a more general observation. The benefit (relative to the SO method) of using one of the new methods for accounts receivable populations noticeably declines as the sample size and/or the error occurrence rate increases.

In all cases the advantages of Table 4 are positive. Negative values often appear in the available-from-author advantage tables for the CS and MD methods for situations where these methods are tested against inventory populations with higher levels of US error taintings. A negative advantage means that, on average, the method did not provide a lower upper confidence bound than that provided by the SO bound. This is to be expected with the CS and MD methods since, as previously indicated, they ignore all the US error taintings in the sample. In contrast, the SO method can use both the US and OS error taintings in the sample.[10]

Average Bounds. The average bounds, as illustrated in Table 5, can be used to study the magnitudes of the confidence bounds that the four methods will achieve with various accounting error populations and sets of conditions. These average bounds should be compared with the actual errors shown on the left side of the table. Table 5 shows 36 of the 72 different inventory-type accounting error populations that were studied. The 36 populations of Table 5 correspond to error model 1. The remaining 36 populations correspond to error model 2.

The extensive range of actual errors (from −2.40 percent to 19.80 percent of book value) in the "Actual Error" column on the left side of the table points out the wide variety of model 1 inventory situations that were tested. The actual errors of model 2 ranged from −4.80 percent to 21.60 percent of book value. As previously noted, we purposely designed the simulations to test the four methods over a wide span of situations. It is also interesting to trace across the table and see the effect of sample size in lowering the 95 percent upper error bound of the four methods. This is particularly revealing for the simulation cases where 50 percent or 70 percent of the error amounts are US taintings. Besides the effect of sample size, one sees the effect of using evaluation methods that utilize US errors (i.e., with the BN and MM methods).

Aggregate Results

While there are obvious disadvantages to aggregating simulation results from several populations, it is helpful for illuminating general relations in the data. (Neter et al. [1984] also used an aggregate approach for presenting the results of an extensive simulation study.) Our simulation results indicate that the level of 100 percent OS taintings is the single most important factor in determining the nominal CL reliability of the four methods (e.g., Table 3). Consequently, aggregated results have been subdivided into two major groups corresponding to (1) ten percent or lower, or (2) 20 percent to 40 percent levels of 100 percent OS taintings. Again, note that these levels define the percentage of the error amounts that are 100 percent OS taintings. In both groups, the rate of occurrence of these error amounts could be quite low.

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[10] These negative advantages were observed for populations with as low as a 20 percent level of US error taintings, especially for higher error occurrence rates, higher sample sizes and/or lower confidence levels. The negative advantages are quite significant when all three influences are present. For example, at a sample size of 240 and a 70 percent confidence level, we observed CS and MD disadvantages of −23.8 and −25.6, respectively, with a population having a 60 percent error occurrence rate for which 20 percent of the errors were US taintings. Higher disadvantages were observed at the 50 percent and 70 percent levels of US error taintings.

TABLE 5

COMPARISON OF AVERAGE CONFIDENCE BOUNDS OF THE FOUR NEW METHODS
EACH VALUE GIVES THE AVERAGE UPPER CONFIDENCE BOUND (AS A PERCENTAGE OF BOOK VALUE) THAT WAS ACHIEVED WITH THE NEW DUS METHOD

Inventory				*95 Percent Confidence Level*											*Model 1*
				Sample Size											
				60				*120*				*240*			
Over Percent	*Under Percent*	*100 Percent*	*Actual Error*	*CS*	*BN*	*MD*	*MM*	*CS*	*BN*	*MD*	*MM*	*CS*	*BN*	*MD*	*MM*
Three Percent Error Occurrence Rate															
80	20	0	0.60	4.12	4.54	4.50	3.67	2.91	2.95	2.84	2.30	2.03	1.94	1.94	1.57
50	50	0	0.00	3.51	4.23	4.20	3.20	2.43	2.49	2.49	1.79	1.65	1.42	1.58	1.04
30	70	0	−0.40	3.02	4.02	3.99	2.65	2.04	2.19	2.26	1.27	1.36	1.07	1.34	0.55
70	20	10	1.50	5.01	5.57	5.90	5.11	3.95	4.13	4.29	3.76	3.16	3.17	3.35	3.00
40	50	10	0.90	4.34	5.26	5.61	4.57	3.45	3.68	3.96	3.21	2.78	2.66	3.03	2.42
20	70	10	0.50	3.82	5.07	5.44	4.16	3.01	3.38	3.75	2.81	2.46	2.31	2.81	2.03
60	20	20	2.40	5.90	6.54	7.24	6.62	4.98	5.19	5.59	5.16	4.25	4.26	4.57	4.29
30	50	20	1.80	5.23	6.26	6.97	6.05	4.45	4.76	5.28	4.58	3.88	3.76	4.26	3.67
10	70	20	1.40	4.61	6.04	6.77	5.59	3.96	4.47	5.08	4.19	3.53	3.42	4.05	3.28
50	20	30	3.30	6.82	7.51	8.51	8.14	6.12	6.32	6.91	6.70	5.46	5.41	5.82	5.69
20	50	30	2.70	6.09	7.20	8.24	7.54	5.57	5.89	6.62	6.07	5.07	4.89	5.50	5.03
0	70	30	2.30	5.33	6.96	8.02	6.98	4.97	5.58	6.40	5.63	4.69	4.55	5.30	4.60
30 Percent Error Occurrence Rate															
80	20	0	1.80	6.29	6.64	6.19	5.15	4.77	4.59	4.65	3.81	3.79	3.42	3.77	3.04
50	50	0	0.00	5.22	5.28	5.27	3.79	3.77	3.02	3.63	2.25	2.83	1.76	2.76	1.39
30	70	0	−1.20	4.30	4.27	4.60	2.28	3.03	1.95	2.94	0.90	2.14	0.61	2.04	0.09
70	20	10	4.50	9.15	10.03	10.03	9.15	7.94	8.16	8.51	7.76	6.97	6.87	7.40	6.71
40	50	10	2.70	8.00	8.65	9.15	7.62	6.99	6.60	7.59	6.11	6.09	5.21	6.46	4.97
20	70	10	1.50	6.97	7.68	8.55	6.48	6.23	5.55	6.97	5.00	5.46	4.07	5.82	3.81
60	20	20	7.20	12.16	13.31	13.63	13.11	11.18	11.45	11.97	11.47	10.24	10.10	10.71	10.19
30	50	20	5.40	10.97	11.96	12.78	11.47	10.28	9.92	11.09	9.71	9.44	8.44	9.79	8.37
10	70	20	4.20	9.88	11.05	12.25	10.39	9.51	8.89	10.50	8.57	8.90	7.34	9.17	7.19
50	20	30	9.90	15.20	16.41	16.99	16.95	14.38	14.54	15.17	14.98	13.39	13.09	13.75	13.42
20	50	30	8.10	13.95	15.06	16.14	15.18	13.49	12.98	14.28	13.14	12.67	11.41	12.82	11.56
0	70	30	6.90	12.69	14.15	15.61	14.06	12.69	11.96	13.70	11.96	12.20	10.32	12.22	10.36
60 Percent Error Occurrence Rate															
80	20	0	3.60	8.80	8.93	8.71	7.27	7.25	6.71	7.26	5.90	6.30	5.49	6.43	5.11
50	50	0	0.00	6.96	5.89	6.84	4.36	5.40	3.46	5.31	2.70	4.42	2.07	4.44	1.71
30	70	0	−2.40	5.58	3.80	5.56	1.75	4.09	1.20	3.94	0.16	3.15	−0.22	3.09	−0.72
70	20	10	9.00	14.85	16.08	16.19	15.07	13.43	13.58	14.34	13.12	12.38	12.00	13.07	11.81
40	50	10	5.40	13.10	13.11	14.51	12.01	11.77	10.38	12.58	9.83	10.70	8.63	11.24	8.36
20	70	10	3.00	11.71	11.12	13.40	9.98	10.59	8.21	11.38	7.66	9.63	6.39	10.03	6.12
60	20	20	14.40	20.77	22.34	22.54	21.93	19.61	19.79	20.58	19.66	18.50	18.03	19.10	18.03
30	50	20	10.80	19.10	19.44	20.93	18.72	18.07	16.59	18.83	16.26	17.00	14.68	17.30	14.54
10	70	20	8.40	17.66	17.48	19.85	16.65	17.04	14.47	17.68	14.04	16.11	12.44	16.09	12.24
50	20	30	19.80	26.69	28.25	28.46	28.46	25.76	25.69	26.46	25.92	24.60	23.80	24.86	24.01
20	50	30	16.20	25.07	25.38	26.88	25.19	24.41	22.56	24.76	22.54	23.31	20.51	23.10	20.55
0	70	30	13.80	23.60	23.47	25.82	23.07	23.50	20.43	23.62	20.26	22.62	18.29	21.90	18.24
Average Values:				10.18	10.81	11.56	10.12	9.25	8.71	9.81	8.37	8.42	7.32	8.64	7.17

Within each of these two groups, aggregate data have been provided for *coverages* and *advantages* categories. These two categories have been further subdivided into sub-categories for accounts receivable and inventory-type populations. These two population types reflect the influence of US error taintings on performance. The level of US error taintings appears to be the second most important factor (after 100 percent OS taintings) in determining nominal CL reliability. As indicated in Table 2, the accounts receivable-type populations had zero to 20 percent weights assigned to the US error tainting distribution. In contrast, the inventory-type populations had 20 percent to 70 percent weights assigned.

We have also separated out in the aggregate data the influence of sample size and CL, and when appropriate the particular error model (i.e., M1, M2, or M3). While the particular populations in each aggregation have not been listed explicitly, the nature of these populations can be determined with the aid of Tables 2 to 6 and the specified parameters that are given for each aggregation.

Aggregate Test Results: Ten Percent or Lower Levels of 100 Percent OS Taintings

Based on our experience and the previously-cited published evidence, it is apparent that auditors generally do not expect to encounter very many populations in which the existing errors tend to be mainly 100 percent OS taintings. Consequently, the results reported in Tables 6, 7, and 8 aggregate what are apparently the more usual types of accounting error populations. In particular, these results are based on tests where ten percent or less of the error tainting amounts are 100 percent OS (with a wide variety of error occurrence rates). This corresponds to results reported by Neter et al. [1985], where it was observed that 100 percent OS taintings are much less frequent on a per-dollar basis than they are on a line-item basis. In particular, of their 20 populations with the largest number of errors (ten accounts receivable and ten inventory), there were only three populations with greater than ten percent levels of 100 percent OS taintings. In these three populations 12 percent, 12 percent, and 66 percent of the items in error were 100 percent OS taintings.

Coverages. Table 6 shows two sets of average coverages for the four methods with populations having zero or ten percent levels of 100 percent OS taintings. Panel A is for accounts receivable-type populations and panel B is for inventory-type populations. In each case, a separate average value is shown for each sample size and CL. Each average value shown in Table 6 is based on 36 simulation analyses (i.e., 18 populations times two models). While highly aggregated, Table 6 does show the general pattern of the detailed data for populations with low levels of 100 percent OS taintings. Note that all four methods have, on average, very conservative confidence bounds since the simulated CLs are considerably higher than the nominal CLs.

For accounts receivable-type populations (with lower levels of US errors), Table 6 shows that, on average, the simulated CLs of the MM method come closest to the nominal CLs. Similarly, on average, the simulated CLs of the MD method are clearly the most conservative. For inventory-type populations (with higher levels of US errors), Table 6 shows that, on average, the simulated CLs of the CS and MD methods are very similar and both extremely conservative (since they do not use the US error taintings in the sample). As with receivables, the simulated inventory CLs of the MM method are again closest to the nominal CLs. They are considerably lower than the CLs of the BN method.

In addition to the average results of Table 6, the frequency of simulations in which the simulated CLs were lower than the nominal CLs is also of interest. For

TABLE 6
AVERAGE OF COVERAGES FOR POPULATIONS WITH ZERO OR TEN PERCENT LEVELS OF 100 PERCENT OS TAINTINGS

Panel A Average of 36 Accounts Receivable Populations: Three Percent, Six Percent, and Ten Percent Error Occurrence Rates

	Sample Size											
	60				*120*				*240*			
CL	*CS*	*BN*	*MD*	*MM*	*CS*	*BN*	*MD*	*MM*	*CS*	*BN*	*MD*	*MM*
95%	99.5	99.7	100.0	99.5	99.3	99.1	99.6	98.7	98.9	98.3	98.9	98.2
90	98.1	98.1	99.8	98.3	97.5	97.4	98.6	97.0	96.8	96.4	97.2	95.7
80	92.3	95.6	98.2	94.8	92.0	93.3	95.3	91.4	91.5	92.0	92.7	89.5
70	85.9	91.4	94.3	89.5	85.5	88.4	89.9	84.1	85.0	86.7	86.7	81.1
50	69.5	78.0	79.4	69.3	70.3	75.4	73.7	63.7	69.4	71.7	70.2	59.9

Panel B Average of 36 Inventory Populations: Ten Percent, 30 Percent, and 60 Percent Error Occurrence Rates

	Sample Size											
	60				*120*				*240*			
CL	*CS*	*BN*	*MD*	*MM*	*CS*	*BN*	*MD*	*MM*	*CS*	*BN*	*MD*	*MM*
95%	99.8	99.7	99.9	96.8	99.8	99.1	99.8	96.5	99.8	98.2	99.8	96.1
90	99.3	98.8	99.5	94.2	99.5	97.8	99.5	93.3	99.5	96.3	99.6	92.3
80	97.9	96.7	98.5	88.3	98.5	94.5	98.7	86.1	98.8	91.7	98.9	84.7
70	95.9	93.7	97.1	81.0	97.0	90.3	97.3	78.3	97.8	86.0	98.0	75.8
50	89.7	83.5	91.1	62.7	93.0	77.6	92.9	58.9	95.0	71.3	95.0	55.9

Note: Each coverage gives a percentage of 500 simulations that had an upper confidence bound that was larger than the actual error in the population.
CL = Confidence Level

accounts receivable-type populations, below-nominal simulated CLs almost never occurred with the MD method (i.e., in 0.09 percent of the tests). For the remaining three methods, below-nominal simulated CLs only occurred for simulations with model 3 and a ten percent level of 100 percent OS taintings (within the zero to ten percent range of 100 percent OS taintings being considered). Panel A of Table 7 summarizes results of 27 such simulation analyses obtained from three error occurrence rates, three sample sizes, and three combinations of OS and US errors. For example, the first entry for the MM method with a 95 percent nominal CL shows that five of the 27 analyses (of model 3 receivables with a ten percent level of 100 percent OS taintings) had below-nominal CLs. The average shortage of these five cases was 1.12. Equivalently, the average coverage of these five cases was 93.88 percent. The second line of the table shows that the maximum shortfall for this case was 1.60. The 80 percent and 70 percent aggregate data for the CS method is bothersome.[11]

Simulated CLs of inventory-type populations that were below nominal only occurrred with the MM method. The average and maximum shortages of the simulated CLs for the below-nominal

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[11] The detailed data show that higher dollar error rates (six percent or greater), lower sample sizes (120 or lower), and few US errors (ten percent or less of the errors are US) bring on these effects, especially at the 70 percent nominal CL.

TABLE 7

BELOW-NOMINAL AVERAGE-COVERAGE STATISTICS FOR POPULATIONS WITH TEN PERCENT LEVELS OF 100 PERCENT OS TAINTINGS

Panel A
Accounts Receivable

CL	*95 Percent*	*80 Percent*	*70 Percent*
BN	1.40 (4)	1.04 (5)	2.60 (8)
max.	2.60	2.80	2.20
CS	0.80 (2)	3.42 (10)	6.38 (19)
max.	1.40	7.60	11.60
MM	1.12 (5)	2.07 (6)	1.92 (14)
max.	1.60	5.00	4.40

Panel B
Inventory

CL	*95 Percent*	*80 Percent*	*70 Percent*
MM	1.45 (35)	3.10 (10)	3.18 (16)
max.	4.40	6.00	7.40

Note: Each first-line decimal value in the table shows the average amount by which the simulated confidence level was less than the nominal confidence level when only considering those cases where the nominal confidence level was not achieved. In each case, the maximum of the individual values used in forming the average is shown as a second-line entry. Each accompanying parenthetical value to the first-line entry indicates the number of applicable cases that was used to calculate the value. Each decimal value presented in panels A and B is the result of 27 and 54 simulations, respectively.
CL = Confidence Level

cases and the number of such cases (out of 54 model M1 and M2 cases at the ten percent level of 100 percent OS taintings) are given in panel B of Table 7. These results reflect the fact that the inventory simulations did not use the more conservative form of the MM method.[12]

Advantages Over SO. Average advantages over the SO bound for the four methods are given in Table 8. As with the previous discussion of this subsection, the table is for populations with a ten percent or lower level of 100 percent OS taintings. Panel A is for accounts receivable-type populations and panel B is for inventory-type populations. Each average value in the receivable panel is based upon 18 simulations with a zero or ten percent level of 100 percent OS taintings (see Table 3). The average values in the inventory panel were based on the same criterion with the further restriction that each population had to have a positive actual error.[13]

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[12] Dworin and Grimlund [1984] introduced two forms of their hypothetical error: a standard form for inventory populations and a more conservative form for accounts receivable populations. Subsequently, Grimlund [1986] investigated the use of the more conservative form of the hypothetical error with inventory-type populations for which there may be a high level of 100 percent OS taintings. With this more conservative form of the hypothetical error, the corresponding 95 percent, 80 percent, and 70 percent CL simulation results are 0.57 (7), 1.48 (6), and 1.51 (9).

[13] The populations that have been excluded can be located using Table 5. Our advantages for these populations are not meaningful. The low actual errors of these populations lead to SO bounds that are frequently near zero. The (percentage) advantages are then determined by dividing by a near-zero number. For these popula-

TABLE 8
AVERAGE OF ADVANTAGES OVER SO BOUND FOR RECEIVABLE AND INVENTORY POPULATIONS

Panel A Accounts Receivable: With Zero or Ten Percent Levels of 100 Percent OS Taintings

		Sample Size											
		60				*120*				*240*			
M	*CL*	*CS*	*BN*	*MD*	*MM*	*CS*	*BN*	*MD*	*MM*	*CS*	*BN*	*MD*	*MM*
1	95%	38.6	34.2	25.1	28.0	25.6	23.8	19.9	23.5	16.4	16.4	15.1	17.7
1	90	37.3	31.2	23.7	26.6	22.7	19.0	17.7	21.4	12.4	11.1	12.1	15.4
1	80	34.0	25.2	21.8	25.2	17.3	11.6	14.5	18.9	5.9	3.8	8.0	12.5
1	70	30.1	19.6	20.3	24.6	11.9	5.4	11.8	17.4	−0.2	−2.0	4.5	10.6
1	50	20.3	9.8	17.0	26.3	−1.0	−4.9	6.5	16.6	−13.6	−11.2	−2.0	8.5
Average		32.1	24.0	21.6	26.1	15.3	11.0	14.1	19.6	4.2	3.6	7.5	12.9
3	95	38.5	38.2	24.2	30.8	24.9	27.8	18.2	23.0	14.6	19.5	13.0	14.7
3	90	38.8	36.1	22.2	29.8	24.7	24.6	15.8	21.6	14.2	16.2	10.5	13.4
3	80	38.1	31.7	19.5	28.8	23.6	19.7	12.5	20.1	12.9	11.7	7.2	12.0
3	70	36.9	27.6	17.4	28.5	22.2	15.8	9.9	19.3	11.6	8.4	4.6	11.2
3	50	33.4	20.7	13.2	29.7	18.5	9.6	5.1	19.1	8.4	3.4	0.0	10.7
Average		37.1	30.9	19.3	29.5	22.8	19.5	12.3	20.6	12.3	11.8	7.1	12.4
Average*		34.6	27.4	20.4	27.8	19.0	15.2	13.2	20.1	8.3	7.7	7.3	12.7

Panel B Inventory: With a Positive Total Error and Zero or Ten Percent Levels of 100 Percent OS Taintings

M	*CL*	*CS*	*BN*	*MD*	*MM*	*CS*	*BN*	*MD*	*MM*	*CS*	*BN*	*MD*	*MM*
1	95%	21.4	14.8	10.5	26.2	5.7	9.4	−1.5	18.9	−7.5	6.3	−12.9	13.0
1	90	18.1	9.7	6.2	24.0	1.3	4.8	−6.5	16.8	−12.6	2.7	−18.2	11.2
1	80	12.1	2.2	−0.3	21.5	−6.2	−1.6	−14.0	14.5	−20.6	−2.0	−26.2	9.2
1	70	5.8	−4.0	−6.3	20.1	−13.5	−6.5	−20.9	13.1	−28.1	−5.5	−33.3	8.1
1	50	−10.3	−14.7	−20.7	20.0	−31.2	−14.6	−36.8	12.5	−45.4	−10.9	−49.2	7.2
Average		9.4	1.6	−2.1	22.4	−8.8	−1.7	−15.9	15.2	−22.8	−1.9	−28.0	9.7
2	95	16.0	16.6	8.8	25.3	−0.6	10.9	−3.8	17.4	−14.1	7.3	−15.4	11.4
2	90	13.1	12.3	3.6	23.1	−4.5	7.1	−9.4	15.4	−18.4	4.4	−21.1	9.8
2	80	7.6	6.2	−4.2	20.5	−10.9	2.1	−17.7	13.2	−25.2	0.8	−29.2	8.1
2	70	2.0	1.3	−11.3	19.1	−17.1	−1.6	−25.1	11.9	−31.4	−1.8	−36.4	7.1
2	50	−12.2	−7.2	−27.8	18.7	−31.9	7.7	−41.6	11.1	−45.4	−5.8	−51.7	6.3
Average		5.3	5.8	−6.2	21.3	−13.0	5.2	−19.5	13.8	−26.9	1.0	−30.8	8.5
Average*		7.4	3.7	−4.2	21.9	−10.9	1.8	−17.7	14.5	−24.9	−0.5	−29.4	9.1

* Each advantage gives a percentage reduction in the average confidence bound (relative to the Stringer Offset) that was achieved with the DUS method.

CL=Confidence Level, M=Model Number (see Table 2)

The receivables data in panel A of Table 8 show that the average advantages (relative to the SO method) tend to decline as the sample size increases and as the nominal CL decreases. As expected, the MD method (with its extremely reliable CLs) offers the smallest advantages relative to the SO method. Of the remaining three methods, the MM method appears to be the only one that does well consistently, relative to the

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tions, this leads to extremely large average advantages for the four methods. The aggregate results in Table 8 would provide a distorted picture of the benefits of the four methods if they included these populations with their large average advantages.

SO method. The CS method also does quite well in certain instances.

The inventory data in panel B of Table 8 point out a number of difficulties with the four new methods that arise when high levels of US errors are present. On average, the model 1 and 2 inventory data are based on populations with, respectively, 40 percent and 30 percent levels of US errors. It is apparent from these data that the CS, BN, and MD methods have, *in general*, little or no incremental value (relative to the SO) in such circumstances.

Aggregate Test Results: 20 Percent to 40 Percent Levels of 100 Percent OS Taintings

This subsection examines the coverages and advantages of the four methods for unusual situations in which more of the existing errors are 100 percent OS. In particular, these results are based on situations where 20 percent to 40 percent of the error tainting amounts are 100 percent OS (with a wide variety of error occurrence rates). For example, the accounts receivable simulations of these circumstances had quite low dollar error occurrence rates (i.e., three to ten percent), but an unusually high percentage of the error amounts were 100 percent OS taintings.

Coverages. Table 9 shows average coverages for the accounts receivable simulations. The two panels of the table provide results for simulations with, respectively, 20 percent and 40 percent levels of 100 percent OS taintings. The table is further subdivided into a subsection for each nominal CL, within which a row of results is shown for each of the two error models (M1 and M3). In panel A each of the rows of average coverages is based on six populations with six and ten percent error occurrence rates. In panel B (for the 40 percent level) the rows of average coverages are based on nine populations with three, six, and ten percent error occurrence rates. Data for the three percent error occurrence rate were excluded from panel A since the four methods had uniformly reliable CLs for simulated populations with a three percent error occurrence rate and a 20 percent level of 100 percent OS taintings.

In addition to the average coverages, each panel of the Table 9 shows the simulated coverage for the individual population that had the lowest (minimum) value. In panels A and B these minimum values are based, respectively, on 12 and 18 individual simulations. Thus, using the two types of data in Table 9, one can examine both the average behavior and the worst-case behavior[14] of the four methods.

Several general conclusions can be made using the accounts receivable data given in Table 9 for populations with 20 percent and 40 percent levels of 100 percent OS taintings. Under these conditions, the MD method has uniformly reliable CLs and the CS method has quite a few serious CL reliability problems, especially for 90 percent and lower nominal CLs. Both the BN and MM methods have sporadic CL reliability problems with the larger OS error taintings of model 3. For 70 percent and higher CLs, these problems are generally more severe with the BN method, especially at the 40 percent level of 100 percent OS taintings. While the sporadic problems of below-nominal coverage with the BN and MM methods tend to dissipate with larger sample sizes, the corrective action of larger sample sizes

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[14] The detailed data for panel A of Table 9 show that 88 percent of the worst cases are for model 3 populations without any offsetting US error taintings. The detailed data for panel B show that 85 percent of the worst cases are for either model 1 or 3 populations without US error taintings.

TABLE 9
AVERAGE OF COVERAGES FOR SELECTED ACCOUNTS RECEIVABLE POPULATIONS

Panel A: Six and Ten Percent Error Occurrence Rates with 20 Percent Levels of 100 Percent OS Taintings

		Sample Size											
		60				*120*				*240*			
CL	*M*	*CS*	*BN*	*MD*	*MM*	*CS*	*BN*	*MD*	*MM*	*CS*	*BN*	*MD*	*MM*
95%	1	99.4	99.5	100.0	99.4	97.1	97.4	97.4	96.9	95.2	95.6	95.9	95.3
	3	93.8	93.4	99.4	94.7	93.9	93.2	96.2	93.5	94.3	92.4	95.4	95.0
Min.		91.2	90.6	97.6	90.0	92.6	90.6	93.6	92.4	92.2	90.6	92.8	94.4
90	1	95.0	98.0	99.9	97.7	92.8	94.5	95.0	93.0	91.4	93.0	93.5	90.9
	3	84.6	85.7	95.5	89.1	85.5	87.0	91.9	88.3	87.8	87.0	90.8	89.9
Min.		80.2	82.2	89.8	84.4	83.0	83.8	89.8	87.4	84.4	83.8	87.4	88.4
80	1	84.5	88.6	91.5	89.4	83.0	87.7	84.5	81.2	82.7	85.5	85.1	81.1
	3	68.8	76.1	85.4	76.5	70.5	76.7	82.9	76.9	74.7	78.1	82.7	80.3
Min.		66.0	72.0	80.6	73.0	67.6	73.8	79.0	75.6	69.0	72.6	77.4	78.6
70	1	74.0	81.5	79.5	78.5	73.0	79.8	77.7	71.3	73.3	77.9	77.4	70.6
	3	56.1	67.3	74.8	65.2	57.6	67.3	73.1	66.6	61.9	68.6	74.0	69.6
Min.		53.2	63.2	70.0	61.8	53.4	64.0	69.8	65.8	58.4	65.0	67.4	67.4
50	1	51.6	62.2	58.6	48.3	51.2	60.2	56.2	46.9	55.0	58.9	58.8	48.6
	3	31.0	48.0	56.3	42.8	35.8	47.7	53.7	44.2	39.3	48.7	55.0	46.2
Min.		27.8	44.0	53.0	40.2	34.8	45.8	48.8	41.0	34.8	46.2	50.6	44.8

Panel B: Three, Six, and Ten Percent Error Occurrence Rates with 40 Percent Levels of 100 Percent OS Taintings

CL	*M*	*CS*	*BN*	*MD*	*MM*	*CS*	*BN*	*MD*	*MM*	*CS*	*BN*	*MD*	*MM*
95%	1	93.7	93.6	97.2	96.4	92.5	92.4	96.5	95.8	92.8	92.8	95.1	94.5
	3	91.1	90.2	97.8	94.2	90.1	88.5	96.6	93.7	92.4	90.8	95.0	94.9
Min.		83.8	82.8	91.4	89.6	88.6	83.6	93.4	92.0	91.0	87.6	93.2	93.6
90	1	85.5	88.6	96.4	93.7	84.1	86.6	94.8	90.0	86.4	88.1	92.6	90.4
	3	78.0	86.1	93.3	90.4	81.2	82.2	91.3	88.9	85.3	85.2	91.5	90.8
Min.		74.0	77.6	86.4	84.0	79.6	80.0	88.4	85.4	83.2	82.4	88.6	87.6
80	1	71.2	79.6	86.4	83.0	71.4	77.2	81.4	79.4	74.4	79.9	83.6	81.8
	3	62.7	67.6	87.4	81.6	66.0	71.6	82.4	79.2	70.4	74.6	83.1	82.0
Min.		56.2	65.8	78.2	77.2	63.0	68.6	77.0	77.4	68.8	72.6	77.8	79.6
70	1	56.0	65.5	82.2	77.5	58.3	68.3	75.9	71.3	62.8	70.8	76.7	72.2
	3	48.4	57.8	75.2	68.2	52.1	61.8	74.5	68.7	57.3	65.1	74.2	71.2
Min.		42.4	51.2	71.2	61.8	48.8	57.4	70.4	65.2	53.4	60.8	69.4	69.6
50	1	33.9	44.7	52.5	46.5	37.7	49.3	55.8	47.6	40.3	50.4	56.8	48.7
	3	27.7	41.3	54.5	43.3	30.6	44.4	54.6	46.8	33.8	45.8	55.4	47.7
Min.		21.2	37.6	49.6	41.4	28.0	41.2	49.4	44.8	31.4	42.2	49.6	44.0

Note: Each coverage gives a percentage of 500 simulations that had an upper confidence bound that was larger than the actual error in the population.
CL = Confidence Level, M = Model Number (see Table 2)

appears to be far more beneficial with the MM method.

Table 10 provides average and minimum data for simulated inventory populations with 20 percent and 30 percent levels of 100 percent OS taintings. It has been set up in the same manner as Table 9. Each reported value in Table 10 is based upon nine simulations that had, on average, a 46.7 percent weight assigned to the US error tainting distribution. The CS and MD methods are, of course, not able to use any of the resulting US error taintings of sampled items.

As expected, the MD method provided very reliable and very conservative CLs. The CS method, which also ignores the US error taintings, did not provide consistently reliable CLs at a sample size of 60. With a few exceptions, the BN method provided very reliable CLs. The MM method has the same CL reliability problems discussed in the last subsection. The procedure discussed in footnote 12 is appropriate for the current circumstances.

Advantages Over SO. Table 11 provides average advantages (relative to the SO method) for accounts receivable and inventory populations with 20 percent and higher levels of 100 percent OS taintings. Each reported result in the table is the average of 18 simulations. The table is organized in the same manner as Table 8. Except as noted below, the general relations discussed in conjunction with Table 8 are also evident with the higher levels of 100 percent OS shown in Table 11.

The relatively high average advantages of the CS method for accounts receivable (shown in panel A of Table 11) must be viewed in light of the method's accompanying CL reliability problems. These were previously seen in Table 9. Similarly, the BN method shows higher advantages for accounts receivable than the MM method, but as previously seen, exhibits more CL reliability problems than the MM method. The rather small average advantages of the BN and MM methods with inventory populations (shown in panel B) should also be noted. It is hard to improve significantly upon the SO bound when considering the rather extreme inventory-type populations on which panel B focuses.

Conclusions

While this paper has pointed out the general relations in the simulation data, an overall evaluation of the four methods of evaluating upper error bounds for dollar-unit samples depends on the criteria important to the reader. Different readers may react differently to the individual deficiencies of the various methods. If a DUS method that will never dip below the nominal confidence level (regardless of circumstances) is required, then none of the four methods are appropriate. However, the Multinomial Dirichlet method might be considered under these circumstances if a slightly less conservative stance can be taken. A price, in terms of efficiency, is being paid for avoiding the infrequent possibility of a slight overstatement of the actual confidence level.

Just how a particular method will be used must also be considered. For example, the simulation results indicate that the Cox and Snell (CS10) bound may be more appropriate at a 95 percent confidence level than at lower confidence levels. At 90 percent and lower confidence levels this bound has quite a few reliability problems. Similarly, the alternative Bayesian Normal bound that is discussed in the Appendix may be of interest at the 95 percent CL. In our view, the Bayesian Normal bound of the main part of the paper and Modified Moment bound

TABLE 10
AVERAGE OF COVERAGES FOR SELECTED INVENTORY POPULATIONS

Panel A: Ten, 30, and 60 Percent Error Occurrence Rates with 20 Percent Levels of 100 Percent OS Taintings

		Sample Size											
		60				*120*				*240*			
CL	*M*	*CS*	*BN*	*MD*	*MM*	*CS*	*BN*	*MD*	*MM*	*CS*	*BN*	*MD*	*MM*
95%	1	96.8	97.8	98.5	93.9	96.3	96.0	98.3	92.6	97.5	94.7	98.6	93.5
	2	98.5	98.0	99.3	92.7	98.8	96.0	99.2	92.8	99.2	95.5	99.4	94.1
Min.		91.8	95.0	96.0	87.8	93.6	92.6	96.2	89.8	94.8	92.4	95.8	92.4
90	1	90.1	95.4	97.0	88.4	93.0	92.7	96.1	88.0	95.6	91.5	97.4	88.7
	2	95.2	95.0	98.4	87.5	96.6	93.0	98.2	88.6	98.1	91.9	98.7	89.3
Min.		82.4	89.2	92.0	82.8	88.0	89.0	92.6	86.2	91.2	88.2	93.6	87.0
80	1	81.1	89.2	91.4	77.9	86.2	85.9	91.6	79.0	90.7	84.6	94.1	79.2
	2	89.3	89.1	94.8	79.6	92.5	86.0	95.9	80.2	95.5	84.2	97.1	79.8
Min.		73.4	80.4	83.2	74.0	79.2	78.6	86.4	74.6	83.2	80.0	87.2	76.8
70	1	70.3	81.9	82.5	67.6	78.5	78.8	86.8	68.6	85.2	76.4	90.3	68.0
	2	89.7	82.2	90.5	69.8	88.0	78.7	92.5	69.9	92.6	75.9	95.1	69.6
Min.		60.4	70.8	75.4	62.4	69.4	68.8	77.8	62.6	73.4	69.0	79.0	65.0
50	1	50.1	62.6	68.2	45.5	62.0	60.4	73.4	47.3	72.7	57.4	81.2	47.5
	2	66.5	63.0	78.0	48.6	77.0	60.3	85.0	48.9	85.9	57.3	90.4	48.5
Min.		40.4	51.6	55.4	40.8	49.8	51.2	58.6	42.6	57.0	48.2	61.8	43.2

Panel B: Ten, 30, and 60 Percent Error Occurrence Rates with 30 Percent Levels of 100 Percent OS Taintings

CL	*M*	*CS*	*BN*	*MD*	*MM*	*CS*	*BN*	*MD*	*MM*	*CS*	*BN*	*MD*	*MM*
95%	1	90.4	96.4	98.0	92.3	93.7	95.2	97.8	93.3	96.4	94.4	98.1	93.6
	2	96.2	96.8	99.0	91.6	97.7	95.7	98.8	93.8	98.7	94.8	99.2	94.3
Min.		79.0	94.0	95.0	85.6	84.8	93.4	96.4	89.8	93.2	93.0	94.8	92.8
90	1	83.5	92.3	94.7	86.2	89.7	91.1	95.4	88.1	94.1	90.5	96.3	89.2
	2	88.8	93.0	96.9	86.8	93.7	92.0	97.5	88.9	97.2	90.9	98.1	89.7
Min.		82.2	87.8	87.8	82.2	85.6	88.2	90.4	84.2	89.4	87.6	92.4	87.6
80	1	67.3	83.0	85.0	77.6	79.3	82.7	89.3	77.8	86.2	82.4	92.8	79.4
	2	80.7	84.8	92.1	77.6	87.9	83.2	94.6	78.4	93.7	82.6	96.5	79.5
Min.		64.8	79.0	79.0	74.0	68.6	77.4	84.2	73.8	74.6	77.6	87.8	76.8
70	1	57.2	75.1	79.1	65.6	68.0	74.3	84.2	67.6	79.6	73.2	87.7	68.4
	2	70.2	75.6	85.8	67.6	80.0	74.4	91.0	68.5	89.4	73.7	94.1	69.2
Min.		51.0	69.0	71.8	60.8	62.0	67.0	74.0	64.4	68.2	68.2	77.2	65.8
50	1	32.8	54.2	59.7	44.8	46.6	55.0	69.7	46.3	59.9	52.4	76.0	46.0
	2	49.5	55.9	74.8	44.8	66.3	55.4	81.6	46.5	77.8	52.8	87.9	46.1
Min.		26.8	47.8	51.8	40.0	28.8	48.0	57.0	43.2	49.2	45.2	60.8	41.8

Note: Each coverage gives a percentage of 500 simulations that had an upper confidence bound that was larger than the actual error in the population.
CL = Confidence Level, M = Model Number (see Table 2)

TABLE 11

AVERAGE OF ADVANTAGES OVER SO BOUND FOR RECEIVABLE AND INVENTORY POPULATIONS

Panel A Accounts Receivable: With 20 to 40 Percent Levels of 100 Percent OS Taintings

		Sample Size											
		60				*120*				*240*			
M	*CL*	*CS*	*BN*	*MD*	*MM*	*CS*	*BN*	*MD*	*MM*	*CS*	*BN*	*MD*	*MM*
1	95%	38.8	35.4	19.5	19.7	25.6	24.2	12.6	13.5	15.6	15.7	7.4	7.3
1	90	39.6	33.9	18.6	19.9	26.0	21.9	11.5	13.4	15.7	13.4	6.3	7.3
1	80	39.5	30.6	17.4	20.8	25.5	18.3	10.2	13.9	15.0	10.3	5.0	7.6
1	70	38.7	27.5	16.6	22.1	24.4	15.5	9.1	14.7	14.1	8.1	4.0	8.3
1	50	35.9	22.8	15.0	26.7	21.4	11.6	7.1	17.7	11.4	5.3	2.1	10.3
Average		38.5	30.0	17.4	21.8	24.6	18.3	10.1	14.6	14.4	10.6	5.0	8.2
3	95	38.4	37.8	19.9	20.5	24.6	26.6	13.2	12.2	13.9	17.7	8.2	5.5
3	90	39.9	36.5	18.5	20.7	26.0	24.6	11.8	12.4	15.1	15.7	7.0	5.7
3	80	40.8	33.5	16.8	21.5	26.9	21.5	10.0	12.9	16.0	13.0	5.3	6.3
3	70	40.9	30.7	15.5	22.6	27.1	19.0	8.6	13.7	16.3	11.0	4.1	7.0
3	50	40.1	26.3	13.1	26.5	26.5	15.5	6.0	16.4	16.0	8.4	1.8	9.0
Average		40.0	33.0	16.8	22.4	26.2	21.4	9.9	13.5	15.5	13.2	5.3	6.7
Average*		39.3	31.5	17.1	22.1	25.4	19.9	10.0	14.1	14.9	11.9	5.1	7.4

Panel B Inventory: With 20 to 30 Percent Levels of 100 Percent OS Taintings

M	*CL*	*CS*	*BN*	*MD*	*MM*	*CS*	*BN*	*MD*	*MM*	*CS*	*BN*	*MD*	*MM*
1	95%	22.7	15.2	8.0	16.1	7.7	9.1	−1.0	9.6	−3.6	5.5	−7.7	5.3
1	90	23.4	12.5	5.7	15.3	8.1	6.9	−3.2	9.0	−3.5	3.8	−9.7	4.9
1	80	23.3	8.8	2.5	14.8	7.7	4.0	−6.3	8.6	−3.9	1.9	−12.4	4.7
1	70	22.5	6.0	−0.2	14.9	6.9	2.0	−8.8	8.7	−4.7	0.6	−14.7	4.8
1	50	19.8	2.2	−5.8	16.7	4.3	−0.5	−14.0	9.9	−6.9	−0.9	−19.0	5.5
Average		22.3	8.9	2.0	15.6	6.9	4.3	−6.7	9.2	−4.5	2.2	−12.7	5.0
2	95	14.7	13.7	−0.2	15.7	−5.0	7.7	−13.2	8.9	−21.4	−4.1	−24.5	4.6
2	90	14.6	10.9	−4.5	14.7	−5.8	5.4	−17.7	8.2	−22.9	2.5	−29.1	4.2
2	80	12.9	7.0	−11.0	14.1	−8.2	2.4	−24.6	7.9	−26.0	0.5	−35.9	4.1
2	70	10.5	4.0	−17.0	14.4	−11.2	0.3	−30.9	8.1	−29.3	−0.8	−42.0	4.3
2	50	2.8	−0.5	−31.4	17.4	−19.7	−2.6	−45.4	10.2	−37.9	−2.4	−55.5	5.7
Average		11.1	7.0	−12.8	15.3	−10.0	2.6	−26.4	8.7	−27.5	0.8	−37.4	4.6
Average*		16.7	8.0	−5.4	15.4	−1.5	3.5	−16.5	8.9	−16.0	1.5	−25.1	4.8

* Each advantage gives a percentage reduction in the average confidence bound (relative to the Stringer Offset) that was achieved with the DUS method.

CL=Confidence Level, M=Model Number (see Table 2)

have more potential as general purpose methods.

Both of these bounds can utilize the understatement errors in a sample and have, on average, simulated confidence levels significantly above their nominal confidence level. While both methods have occasional problems with their nominal reliability, this must be balanced against the apparently infrequent nature of the populations for which these problems arise. As has been discussed, such problems arise when a high percentage of error amounts are 100 percent overstatement error taintings (for a variety of error occurrence rates). Consequently, it is important that these methods have a more conservative alternative form that an auditor can select when such conditions are anticipated. Grimlund [1986] has provided such a procedure for the Modified Moment method. A similar procedure could be set up for the Bayesian Normal method. More generally, all four methods could be fine-tuned by varying or changing their Bayesian prior or hypothetical error. Consequently, the results in this paper reflect the current form of the methods and do not necessarily indicate that it is not possible to find a new and more attractive form.

APPENDIX

As indicated in the main part of this paper, the Bayesian Normal and Cox and Snell bounds that were used in this paper have alternative formulations that are based upon alternative priors. In particular, Smieliauskas [1986] used a different prior for his "N2" (Bayesian Normal) bound than that used by Menzefricke and Smieliauskas [1984]. Similarly, Neter and Godfrey [1985] give simulation results for a series of priors, including the "CS10" prior (i.e., the CS bound of the main part of the paper) and a second-most reliable "CS11" prior. For completeness, we have included results for these alternative priors in consideration of the interest indicated in them by their authors.

The N2 and CS11 bounds have been examined at the same level of detail and with the same test populations as were used for all the other bounds. In total, 2,160,000 separate confidence bounds were calculated while testing the performance of these two alternatives with 144 different populations at three sample sizes and five confidence levels. A summary of these results is given in Tables A1 and A2.

Each average magnitude in these tables summarizes the coverage problems that were found in nine simulation analyses (i.e., cases). For example, Table A1 shows a value of 6.35 for a sample size of 60 at an 80 percent confidence level with model 3 (as defined in Table 2) type error taintings supplemented with a ten percent level of 100 percent OS taintings. Directly below, a value of four appears. This means that four out of the nine simulations for these conditions had a simulated confidence level of less than 80 percent. In particular, the average simulated confidence level for these four simulations at the nominal 80 percent CL was 80 percent reduced by the table value of 6.35 percent or 73.65 percent. The remaining five simulations had simulated confidence levels that were greater than the nominal 80 percent CL.

In summary, Tables A1 and A2 show that both of these alternative approaches have ranges of conditions in which the bounds are reliable. For example, the alternative BN bound may be quite useful at a 95 percent CL when low levels of 100 percent OS errors are expected. Subject to this constraint, this bound would be appropriate if an auditor wished to use a high CL and not place much reliance on other types of audit procedures. This is consistent with the diffuse Bayesian prior used to construct the alternate BN bound.

More generally, the performance of both of the alternative approaches must be questioned as general purpose methods that can be used over a variety of confidence levels and expectations about the nature of accounting errors. However, with additional developmental

TABLE A1

AVERAGE MAGNITUDE OF THE BELOW-NOMINAL COVERAGES FOR THE ALTERNATIVE BN METHOD

Panel A: Simulations of Accounts Receivable Populations

		Sample Size											
		60				*120*				*240*			
		Percent of 100% OS Taintings				*Percent of 100% OS Taintings*				*Percent of 100% OS Taintings*			
CL	*M*	*Zero %*	*Ten %*	*20 %*	*40 %*	*Zero %*	*Ten %*	*20 %*	*40 %*	*Zero %*	*Ten %*	*20 %*	*40 %*
95%	1				5.80		2.33	2.87	2.63		4.43	2.78	2.22
	3			2.73	4.07	3.20	2.92	4.33	3.90	2.37	3.18	3.87	3.20
Cases				0,3	3,3	0,1	3,5	6,6	6,6	0,6	6,8	9,9	9,9
80	1		2.80	7.57	6.67		5.00	5.07	3.60		4.24	4.04	2.16
	3	4.20	6.35	7.97	5.58	2.76	5.35	7.24	5.13	3.38	6.04	5.89	4.04
Cases		0,1	3,4	6,6	6,9	0,5	6,8	9,9	9,9	0,8	9,9	9,9	9,9
70	1		6.80	8.23	5.91		3.91	7.78	4.43	0.60	5.89	4.04	2.67
	3	3.80	8.00	7.29	8.38	5.07	6.82	8.22	5.07	5.09	6.62	5.80	3.62
Cases		0,5	5,6	6,9	9,9	0,6	9,9	9,9	9,9	1,9	9,9	9,9	9,9

Panel B: Simulations of Inventory Populations

		Percent of 100% OS Taintings				*Percent of 100% OS Taintings*				*Percent of 100% OS Taintings*			
CL	*M*	*Zero %*	*Ten %*	*20 %*	*30 %*	*Zero %*	*Ten %*	*20 %*	*30 %*	*Zero %*	*Ten %*	*20 %*	*30 %*
95%	1		4.93	4.20	3.56		3.26	3.80	3.36	0.40	2.98	3.04	2.80
	2	1.40	2.30	2.93	2.73	2.60	1.83	3.16	2.11	1.27	1.60	2.64	1.93
Cases		0,1	6,6	6,6	9,9	0,2	7,7	9,9	9,9	1,3	9,9	9,9	9,9
80	1		5.11	6.13	3.53	2.00	4.49	3.89	3.24	1.80	3.49	3.13	2.20
	2	2.40	4.60	4.33	4.63	4.20	2.49	3.29	3.31	2.80	4.06	2.91	2.24
Cases		0,2	7,7	9,9	8,8	1,3	9,9	9,9	9,9	2,4	9,7	8,9	9,9
70	1	1.40	4.98	4.76	5.35	1.00	3.42	3.02	2.71	3.20	3.36	3.49	2.38
	2	3.20	4.18	4.33	4.58	3.40	2.69	3.53	3.18	3.04	3.31	3.68	2.18
Cases		1,3	9,9	9,9	8,8	3,4	9,9	9,9	9,8	3,5	9,9	9,8	9,8

Legend: Nine simulations were run for each sample size, confidence level (CL), model (M), and 100 percent OS error tainting combination. The average of the coverage errors for those cases (maximum 9) with below-nominal coverage is shown. The number of such cases that were used to form the averages are shown for models M1 and M3 (or M2 in panel B) in the 'Cases' lines.
CL=Confidence Level, M=Model Number (see Table 2)

work the BN method (with its ability to handle US errors) could be quite useful in the event that auditors adopt a Bayesian perspective and start selecting prior judgments as part of the statistical auditing process.

Table A2

Average Magnitude of the Below-Nominal Coverages for an Alternative CS Method

Panel A: Simulations of Accounts Receivable Populations

		Sample Size											
		60				*120*				*240*			
		Percent of 100% OS Taintings				*Percent of 100% OS Taintings*				*Percent of 100% OS Taintings*			
CL	*M*	*Zero %*	*Ten %*	*20 %*	*40 %*	*Zero %*	*Ten %*	*20 %*	*40 %*	*Zero %*	*Ten %*	*20 %*	*40 %*
95%	1		3.67	11.93	12.96		5.70	8.62	10.71		5.18	7.87	4.87
	3	1.92	6.63	10.89	12.71	1.73	3.33	5.82	6.40	0.90	2.40	2.93	2.78
Cases		0,5	3,7	6,9	9,9	0,3	6,9	9,9	9,9	9,2	9,8	9,9	9,8
80	1		10.26	17.82	20.73		7.93	14.47	13.78		8.33	8.60	7.60
	3	8.27	16.60	19.98	20.98	5.58	12.44	15.22	13.64	3.80	7.51	7.80	7.27
Cases		0,9	7,9	9,9	9,9	0,9	9,9	9,9	9,9	0,7	8,9	9,9	9,9
70	1		10.10	19.11	20.67		8.51	15.29	14.80		6.78	9.51	8.47
	3	12.33	19.33	21.33	25.11	8.60	14.38	17.18	16.18	5.90	9.80	10.47	9.40
Cases		0,9	8,9	9,9	9,9	0,9	9,9	9,9	9,9	0,8	8,9	9,9	9,9

Panel B: Simulations of Inventory Populations

		Percent of 100% OS Taintings				*Percent of 100% OS Taintings*				*Percent of 100% OS Taintings*			
CL	*M*	*Zero %*	*Ten %*	*20 %*	*30 %*	*Zero %*	*Ten %*	*20 %*	*30 %*	*Zero %*	*Ten %*	*20 %*	*30 %*
95%	1		3.55	9.80	8.50		3.47	4.04	6.70		2.30	2.50	1.70
	2		0.20	4.67	9.40		0.40	1.70	4.00			0.60	0.40
Cases			4,1	6,3	6,4		3,1	5,2	4,1		2,0	2,1	2,1
80	1		6.15	8.40	12.46		2.50	5.30	7.45			4.40	3.20
	2		8.00	5.10	7.20			7.20	7.20				
Cases			4,1	6,4	7,4		2,0	4,1	4,1			1,0	1,0
70	1		6.87	7.56	12.51		3.40	3.75	5.00			3.80	2.80
	2		4.10	6.20	13.50			7.00	6.80				
Cases			3,2	5,3	7,4		1,0	4,1	4,1			1,0	1,0

Legend: Nine simulations were run for each sample size, confidence level (CL), model (M), and 100 percent OS error tainting combination. The average of the coverage errors for those cases (maximum 9) with below-nominal coverage is shown. The number of such cases that were used to form the averages are shown for models M1 and M3 (or M2 in panel B) in the 'Cases' lines.

CL = Confidence Level, M = Model Number (see Table 2)

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Taxes and Off-Balance-Sheet Financing: Research and Development Limited Partnerships

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ABSTRACT: Research and development limited partnerships are a relatively recent alternative to the more traditional debt and equity funding of research and development costs. This paper provides an economic and empirical analysis of the factors that may motivate firms to select limited partnerships as a source of funding. The analysis uses a framework that relies on extant capital structure models and agency theory to derive empirically testable hypotheses. Results of the empirical tests are consistent with both a tax motivation and, to a lesser extent, an off-balance-sheet motivation for firms to use a limited partnership to fund their research and development costs. More generally, the analysis and results offer support for the clientele tax models of Miller [1977] and DeAngelo and Masulis [1980], and the analysis of taxes by Scholes and Wolfson [1984] and Majd and Myers [1985]. The off-balance-sheet results offer some support for agency model predictions.

RESEARCH and development limited partnerships are a relatively recent phenomenom used by firms to finance research and development (R&D) projects. These partnerships are an alternative source of funding to the more traditional debt and equity funding sources (i.e., in-house). The Department of Commerce estimates that during the period 1981–1984, over $2.3 billion was raised through R&D limited partnerships (see Department of Commerce [1984]). The purpose of this paper is to provide an analysis and empirical tests of the factors suggested (e.g., see Spohr and Wat [1983] and/or Garahan, Fuller, and Chiltern [1983]) to influence a firm's choice between funding research and development through a limited partnership (*LP*) or in-house.

Factors favoring use of an *LP* include taxes, off-balance-sheet financing, and risk shifting from the R&D firm onto other parties. An R&D *LP* allows relatively low-tax firms to transfer (sell)

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the tax benefits arising from the deductibility of expenditures on R&D to more highly taxed entities, together with possible capital gains treatment of the payoffs to these entities. An *LP* also avoids some of the financial statement effects of in-house funding. Most R&D firms disclose *LP* details in financial statement notes. Therefore, the amount raised through the *LP* does not appear as debt on the R&D firm's balance sheet, nor does the *LP*-funded R&D expenditure appear as an expense on the income statement. That this factor may be important is evidenced by the concern of the SEC and FASB that resulted in the release of SFAS 68, "Research and Development Arrangements," in 1982. R&D is a risky activity and an *LP* may be a way to shift this risk to other parties who may be more efficient in bearing the risk. However, risk-averse investors will demand risk premiums, increasing the cost of *LP* funds to the R&D firm. Factors that work against the use of an R&D *LP* and which, therefore, favor in-house funding, include the transaction costs of establishing an *LP* and any costs of disclosing competitive secrets. An *LP* also gives rise to incentive problems (conflicts of interest) between the R&D firm and the limited partnership's investors.

This paper uses a framework that relies on extant capital structure models and agency theory to derive formal hypotheses. In particular, the analysis predicts that low marginal tax-rate firms are more likely than high marginal tax-rate firms to fund their R&D through limited partnerships. Multiple regression tests are conducted using logit procedures with a binary dependent variable (set equal to one for an R&D firm with an *LP* and zero for R&D firms funding all their R&D in-house). In these logit regression tests, after controlling for firm size differences, a marginal tax rate variable is found to be significant, although this result is sensitive to the measurement of marginal tax rates. An alternative tax variable (*LP* amount divided by taxable income), based on the analysis by Majd and Myers [1985], avoids some of the measurement problems associated with a marginal tax rate variable and is also found to be significant.

The off-balance-sheet motivation for firms to use an *LP* is operationalized using agency theory (or contracting cost arguments). The variables used to empirically test this motivation are leverage, interest coverage, and dummy variables for the existence of a dividend covenant and a management bonus plan. In the logit regression tests, only the management bonus plan variable is significant in the predicted direction. However, when the leverage and interest coverage variables are estimated as if the *LP*-funded R&D were actually funded in-house using all debt, the regression coefficients on these variables are significant in the predicted direction. As-if measurement of variables is used in an effort to capture the possibility that firms may be motivated to choose the *LP* route to avoid covenant violations that might arise if the R&D were funded in-house. However, the construction of the as-if variables assuming all debt may bias the tests toward the reported finding and thus overstate their significance. A check on this bias is provided by assuming the as-if funding maintains the existing debt/equity mix. Under this as-if assumption, the interest coverage ratio remains significant but the leverage ratio loses its significance. Overall, the management bonus plan and as-if leverage and interest coverage results offer some support for the off-balance-sheet motivation.

The existing empirical evidence offers mixed support for extant capital structure models. The analysis and results reported here offer support for the clientele tax models of Miller [1977], DeAngelo and Masulis [1980], and Scholes and Wolfson [1984], as well as the tax model presented by Majd and Myers [1985]. In addition, further evidence on the explanatory power of agency theory (or contracting cost) predictions is provided.[1] It might be thought, *a priori*, that taxes being "first-order" effects might dominate the "second-order" contracting cost effects of the off-balance-sheet motivation such that variables representing the latter may have little explanatory ability. However, the results for the as-if leverage, as-if interest coverage, and management compensation variables suggest that both taxes and contracting cost variables have incremental explanatory power in the R&D funding choice. Thus, the results offer some support for agency model predictions.

The remainder of the paper is organized as follows. Section I presents a brief discussion of the relevant institutional details of R&D limited partnerships. Section II develops the R&D funding choice hypotheses to be tested. Section III discusses sample selection procedures and measurement of variables, and profiles the sample firms. The econometric procedures and results of hypothesis tests are reported in Section IV. The paper concludes with a brief summary in Section V.

I. R&D LIMITED PARTNERSHIPS

The basic partnership structure is presented in Figure 1 (see Shevlin [1986], Garahan et al. [1983], and/or Spohr and Wat [1983] for more details). A sponsoring R&D corporation forms a limited partnership with investors (the limited partners) and transfers the rights to an idea (the base technology) to the partnership through, for example, a non-exclusive license to use and modify the base technology. In return, the sponsor obtains a general partner's interest in the partnership and first option at exploiting any developed technology (through a purchase and/or license option). The general partner acts as the manager making all decisions on behalf of the partnership, while the limited partners enjoy limited liability provided they do not engage in the management of the *LP*.

The research and development work is contracted out by the *LP* to an R&D contractor (usually the sponsor or an affiliate). Payments to the R&D contractor result in losses to the partnership in the early periods. These losses are usually tax deductible by the limited partners in their personal returns.[2] Further, the limited partners' funds must be at-risk, as defined under Section 465 of the Internal Revenue Code, for the deductions to flow through to the limited partners. This at-risk provision means that the sponsor firm cannot guarantee payments to the limited partners without imperiling the tax deduction of losses to the limited partners. The Tax Reform

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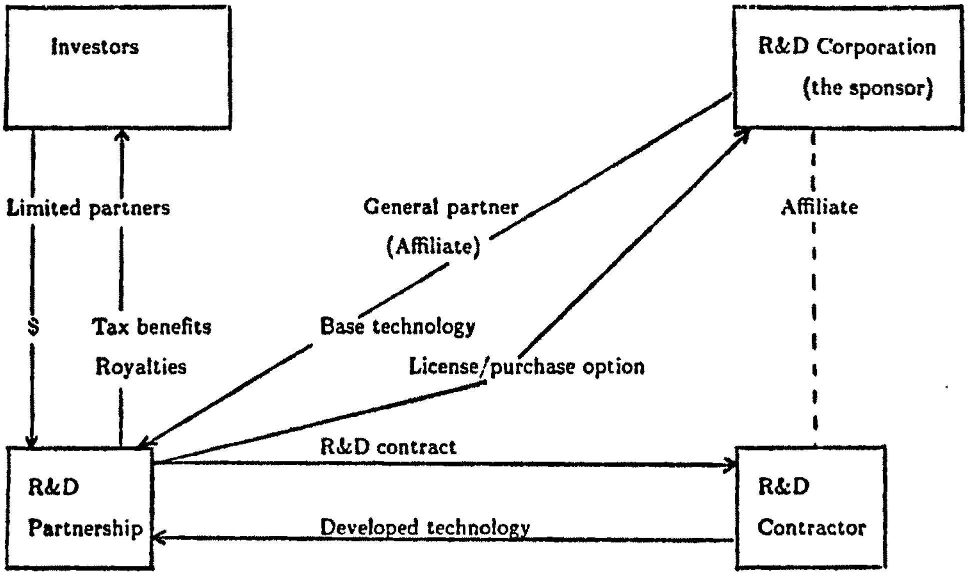
[1] See Holthausen and Leftwich [1983], Kelly [1983], and Watts and Zimmerman [1986] for a review of both agency theory and the existing evidence.

[2] This is a key tax feature of R&D *LPs* which was settled in the courts in 1974 by the Supreme Court's decision in the Snow case. The court held that under Section 174 of the IRC, Snow was entitled to deduct his share of the partnership R&D expenditures in the year in which they were paid, even though the partnership was not yet carrying on any trade or business. The decision was based on the opinion that "in connection with" a trade or business is a looser construction than "in carrying on" a trade or business as used in Section 162 (which is concerned with the deductions of ordinary business expenses). The Internal Revenue Service's (IRS) general approach had been to deny the "carrying on a trade or business" status until income has been realized or some product has been offered for sale. Note, further, that the payments to the R&D contractor are taxable revenues to the contractor. If the limited partners were to deduct the R&D payments at 50 percent while the firm has to pay taxes on the receipt of these payments at 46 percent, there would be only a small tax gain to using an *LP*. It is predicted in the next section that the R&D firm's tax rate is less than 46 percent.

FIGURE 1
STRUCTURE OF R&D ROYALTY PARTNERSHIP



A sponsor R&D corporation forms a limited partnership (*LP*) with investors (the limited partners). In return for a general partner's interest in the *LP*, the sponsor transfers the rights to an idea (the base technology) to the *LP*. The R&D work is contracted out by the *LP* to the sponsor or an affiliate of the sponsor (the R&D contractor). The payments to the R&D contractor provide the tax benefits (deduction of partnership losses) to the limited partners. Any successfully developed technology is owned by the *LP*. Income (royalties) are earned by selling or licensing the technology to the R&D corporation.

Act of 1976 and the Revenue Act of 1978 restricted the limited partners' ability to deduct losses up to the amount the investors are personally liable. This limited the use of nonrecourse borrowing to increase tax writeoffs.

Income to the *LP* may be earned either through selling or licensing the developed technology to the sponsor (as in a royalty partnership) or by forming a new firm to exploit the technology. The new firm could be a joint venture between the sponsor and the *LP* or it could be via an issue of equity in the sponsor firm to the limited partners as in an equity partnership.[3] The tax benefits of the *LP* result in a lower pre-tax rate of return required by the limited partners, which lowers the cost of funds to the R&D firm.

II. THEORY AND DEVELOPMENT OF HYPOTHESES

Tax Effects

A low-tax R&D firm funding R&D in-house (through debt and/or equity) would not realize the full advantage of the tax deductibility of R&D expenditures because either the deduction is taken at a lower current rate or is deferred until future periods (where it may or may not be taken at the top rate). If the deduction is deferred, the present value of the expected deduction is less than the value of immediate deduction at the top rate because of positive interest rates and a probability less than one of using all deductions carried forward (because of bankruptcy or insufficient taxable income). This increases the after-tax cost of the funds relative to the *LP* alternative. Further, if a low-tax firm were to use debt to finance the R&D, the tax advantages of debt (interest deductibility) would not be fully realized. This analysis suggests the following tax hypothesis (all hypotheses are stated as the alternative with the null hypothesis being the complement):

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[3] The sponsor R&D firms usually hold both license and purchase options. Firms sometimes exercise their license option before purchasing to evaluate further the developed technology. Capital gains apply only to sales (even if the purchase consideration includes contingent royalty payments). Income to the limited partners from licensing any developed technology is taxed at ordinary rates. Section 1235 of the IRC specifies conditions under which the sale of developed technology will be accorded favorable capital gains treatment, while Sections 1221-1223 and Section 1231 contain the general capital gains provisions. Section 741 details the conditions under which the sale of a partnership interest is treated as a capital asset sale.

$$H_1: \tau_{c0}^{LP} < \tau_{c0}^{IH}$$

where τ_{c0} is the R&D firm's marginal corporate tax rate in period zero and the superscripts denote the financing route (*LP* or in-house *IH*).[4]

An alternative approach to reduce the tax motivation to an empirically testable hypothesis is offered by the analysis in Majd and Myers [1985]. Majd and Myers argue that undiversified firms, or projects forced to stand alone, are at a significant tax disadvantage because of the asymmetric tax treatment of corporate gains and losses. Income is taxed only when positive; the carryback and carryforward tax rules reduce the asymmetry but do not fully remove it. Applying the Majd and Myers arguments to R&D investment, smaller firms (including start-ups) are predicted to be motivated by this tax asymmetry to fund their major R&D activities through *LP*s. Wealthy limited partners tend to be diversified and hence face symmetric tax treatment on the profits and losses from the investment. The key tax measure in *LP* funding suggested by the Majd and Myers analysis is the R&D project's size relative to the firm's expected taxable income (from all sources). The higher this ratio, the more likely it is that a firm will choose the *LP* route. The model underlying H_1 is, in terms of firms' marginal tax rates, consistent with most models in the capital structure literature. These rates are expected to capture the Majd and Myers prediction; the lower the marginal tax rate, the lower the other sources of taxable income against which the R&D deduction may be offset. However, there are problems with the measurement of marginal tax rates (discussed below), and thus evidence using the (*LP* amount/taxable income) ratio is also provided.

The tax hypothesis and empirical analysis focus on period zero tax comparisons, where period zero refers to the period in which the R&D expenditures are to be made. This period zero focus emphasizes tax benefits of the R&D deduction and ignores taxes on the payoffs. It is argued that the uncertainty of future payoffs, both as to their timing and tax treatment (ordinary income or capital gain), may lead an R&D firm to use that organizational form which can best utilize the current deduction for R&D expenditures. Further, focusing the analysis on period zero is not meant to imply that future tax rate comparisons are not important. (In fact, analysis in

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[4] The tax hypothesis may be derived using the tax clientele arguments presented in Miller [1977] and Scholes and Wolfson [1984]. See Shevlin [1986] for this derivation. Martin and Kensinger [1986] provide a simple example illustrating the potential tax gains to low-tax firms of using an *LP* to transfer the R&D deduction to high-tax individuals. Scholes and Wolfson [1984] list R&D *LP*s as one means by which low-tax corporations may transfer or sell tax benefits to high-tax entities. Neither Martin and Kensinger or Scholes and Wolfson empirically test this hypothesis.

FIGURE 2
A SUMMARY OF THE FINANCIAL STATEMENT EFFECTS ON R&D FIRMS OF *LP* VS IN-HOUSE FUNDING OF R&D

	Accounting periods	
Funding method	*R&D expenditure* *t*=0	*R&D payoffs* *t*=1
LP	No effect on profits or balance sheet	Profits less royalties to *LP*
In-house	R&D deduction decreases profits decreases interest coverage decreases retained earnings	Payoffs belong to firm increasing profits
Equity	Decreases EPS Decreases leverage	Dividends on equity
Debt	Interest expense decreases profits decreases interest coverage decreases retained earnings Increases leverage	Debt must be repaid

Note: The above assumes the *LP* is disclosed in the footnotes to the financial statements of the R&D firm and is not (a) reported as debt on the balance sheet or (b) equity accounted or (c) consolidated into the R&D firm's financial statements.

Shevlin [1986] suggests that some firms facing changes in their marginal tax rates may be misclassified, which may reduce the power of the empirical tests.) However, expected future marginal tax rates are extremely difficult to estimate reliably, given that they are conditional (endogenous) on future managerial decisions and outcomes.

The LP *as Off-Balance-Sheet Financing*

The off-balance-sheet motivation is reduced to testable empirical hypotheses using agency theory. Agency theory (also referred to as economic consequences and contracting cost theory) is used in several research areas to provide explanations for observed phenomena: lobbying behavior, impact of accounting choices on stock prices, accounting method choice, and investment decisions.[5]

An *LP* offers an R&D firm a way to avoid the costs of possible bond covenant violations that might arise if the firm were to fund the R&D in-house. Financial statement effects of *LP* funding relative to in-house funding are presented in Figure 2. Relative to *LP* funding, in-house funding reduces initial period profits through the write-off (expensing) of R&D expenditures (which is required under SFAS 2 [1974]), but in-house profits are relatively higher in the payoff periods if the project is successful because the royalties paid under the *LP* route are avoided. Since an *LP* avoids the short-term negative impact on reported earnings, an *LP* avoids decreases in the interest coverage ratio and unrestricted retained earnings (URE) pool. Further, in-house funding requires debt and/or equity funds. The use of debt for in-house funding will increase the debt-to-equity (leverage) ratio and will further reduce reported earnings (and earnings per share) in period zero through the interest expense and, thus, reduce the interest coverage ratio. On the other hand, the issuance of new equity for in-house funding will decrease the leverage ratio but may also reduce earnings per share in period zero (through an increase in the number of shares outstanding).

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[5] Watts and Zimmerman [1986], among others, provide a review of these applications of agency theory to accounting issues. The studies most closely related to this paper, along the agency dimension, are: Kelly's [1982] study of firms' changes in financing and operating activities in response to SFAS 8; Larcker's [1983 and 1984] studies of the impact of management compensation schemes on firms' investment (expenditure) decisions; and Elliot et al.'s [1984] study on the effect of SFAS 2 on firms' R&D expenditure patterns. These studies provide mixed empirical support for the agency theory predictions.

This analysis of the financial effects of the alternative funding instruments suggests that firms concerned with violating their covenants may choose the *LP* route to avoid the negative impact on profits, interest coverage, and leverage of in-house funding. Thus, under the off-balance-sheet motivation, firms observed using *LP*s are hypothesized to be closer to their covenants. That is, the leverage ratio for the *LP* firms will be higher than for the in-house firms, while the interest coverage ratio will be lower for the *LP* firms. Stated in terms of hypotheses:

H_2: $\text{leverage}^{LP} > \text{leverage}^{IH}$
H_3: $\text{interest coverage}^{LP} < \text{interest coverage}^{IH}$

The analysis of the financial statement effect of *LP*s and the application of agency theory suggests that dividend covenant restrictions and management compensation may also be affected by the funding choice. With respect to a dividend covenant expressed in terms of a dividends-to-URE (div/URE) ratio, analysis of the firms in this study indicates that many firms did not pay dividends (over 80 percent of the *LP* firms), either because they were restricted by bond covenants or had negative retained earnings (most states allow ordinary dividends to be declared only by firms with positive retained earnings balances). For these zero-dividend firms, div/URE = 0 is difficult to interpret. Further, data on URE are unavailable in over 75 percent of the sample firms. To avoid measurement problems and the resulting interpretation difficulties, a dummy variable (div cov) is used instead of the div/URE ratio in the empirical tests. The div cov variable is set equal to one if the firm discloses the existence of a dividend covenant restriction and zero otherwise. The above analysis suggests that the frequency of dividend covenants will be higher in the *LP* sample than in the in-house sample. Formally:

H_4: $\text{Frequency(divcov)}^{LP} > \text{Frequency(divcov)}^{IH}$

Since an *LP* avoids the short-term negative impact of R&D expenditures on earnings, firms in which managers are compensated by bonus schemes (defined in terms of accounting earnings) may be more likely to use an *LP* than firms that do not have such schemes. Formally:

H_5: $\text{Frequency(mcomp)}^{LP} > \text{Frequency(mcomp)}^{IH}$

where mcomp is a dummy variable set equal to one if the R&D firm has a management bonus scheme (with the bonus defined as a function of reported earnings) and zero otherwise.

The off-balance-sheet hypotheses assume that the R&D firms are not required to report the *LP* on the balance sheet. In 1982 the FASB issued SFAS 68, "Accounting for R&D Arrangements," which specifies that to the extent the

R&D firm is obligated to repay the limited partners, it should record a liability and charge the R&D costs to expense as incurred. Prior to 1982, firms could report the *LP* in accordance with how they interpreted generally accepted accounting principles. Over 95 percent of 80 *LP* observations, for which such data are available, were disclosed in the notes to the financial statements (both before and after SFAS 68). Only two firms reported the *LP* as debt on the balance sheet (one before and one after SFAS 68). Further, the sponsor firms retained, on average, less than five percent ownership in the *LP*. While this is less than the 20 percent cutoff to determine whether equity accounting is appropriate, the sponsor firms (or an affiliate) as a general partner control the *LP*'s operations. On this basis it would appear that the R&D firms should equity account for the *LP* (see APB Opinion 18 [1971] and FASB Interpretation No. 35 [1981]). However, only one firm used the equity method (and it retained 26.5 percent share of *LP* ownership). Based on these data, it appears that the accounting for R&D *LPs* in the financial statements of R&D firms did not change as a result of SFAS 68, with the majority of firms choosing footnote disclosure.

Some Caveats with Respect to the Hypotheses

There are several *caveats* with respect to the above hypotheses and variables which may affect the ability of empirical tests to reject each null hypothesis. These *caveats* may be classified into omitted variables issues and measurement issues.

There are several factors other than those discussed above that may influence the R&D funding choice. First, the *LP* may be a way for firms to shift or share the risk of R&D development with other parties. However, risk sharing is not costless to the firm because risk-averse investors will demand risk premiums on *LP* investments. Second, incentive problems between the R&D firm and the limited partners give rise to agency costs that increase the cost of funds.[6] If the agency costs associated with *LPs* are greater than those of debt and/or equity (see Jensen and Meckling [1976] and Myers and Majluf [1984]), *LPs* become relatively less attractive to all firms and may lead some low-tax firms to prefer in-house equity funding (depending on the relative agency costs of each security type). Third, there are high transaction (issuance) costs associated with *LPs* which increase the relative cost of *LP* financing to all firms. Finally, to the extent that more information is disclosed through the *LP* route and there are competitive disadvantages associated with this disclosure, there is a further disincentive to use an *LP*.

The incentive, transaction, and disclosure costs associated with R&D *LPs* may, at the margin, induce some low-tax firms to favor in-house funding of R&D. However, due to measurement problems and lack of data for both *LP* and in-house funded R&D, no variables are included to capture these costs. Further, risk shifting may motivate some high-tax firms to use *LP*s rather than in-house funding of R&D. Again due to measurement problems and lack of data on the risk characteristics of both *LP* and in-house funded R&D, no variables are included to capture the risk motivation. Omission of these variables may bias the tests against rejection of the tax null hypothesis.

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[6] Wolfson [1985] discusses the incentive problems associated with oil and gas limited partnerships which are similar to those encountered in R&D *LPs*. Briefly, these incentive problems include the provision and pricing of goods and services provided by the R&D firm to the *LP* (resource allocation), the R&D firm learning information relevant to other projects from the *LP*-funded project (proving up), all revenues or income arising from the R&D program not being fully measurable (payoff allocation and measurement), the R&D firm continuing the program when it is no longer economically justifiable from the limited partners' viewpoint (overinvestment), and the R&D firm not exercising its option to exploit commercially the developed technology (undercompletion). Shevlin [1986] provides an analysis of these problems to indicate the specific conditions in which they are likely to be most severe. Predictions as to how firms may mitigate these problems are offered and supported, where possible, by descriptive data on the contractual provisions of the limited partnerships and on the types of projects funded by *LPs*. This analysis is exploratory rather than formal hypothesis-testing because of the lack of data on both the *LPs* and the R&D funded in-house.

With respect to the leverage, interest coverage, and dividend covenant hypotheses, it is implicitly assumed that the bond covenants do not incorporate rules for adjusting the reported numbers to reflect the effects of the limited partnerships and/or that the costs to the firms of adjusting the contracts are high. Second, these variables proxy for a firm's proximity to its bond constraints and these constraints may vary cross-sectionally, for example, across industries. Using the above ratios will induce measurement error if there exist cross-sectional differences in constraints. Related to this, Scott [1977] argues that where growth potential is imbedded in intangible assets (such as R&D), firms will use less debt and more equity in the capital structure because monitoring in this environment is more difficult and costly. Thus, R&D firms will have lower leverage ratios relative to other firms. However, these lower ratios may be reflected in the bond covenants so that in a cross-sectional test where both *LP* and in-house firms are drawn from similar industries, this R&D factor will be (implicitly) controlled.

Finally, there are several assumptions implicit in the management bonus scheme hypothesis and to the extent these assumptions do not hold, the explanatory power of this hypothesis is reduced. First, the hypothesis implicitly assumes that the bonus target is chosen before the managers choose whether to conduct R&D through an *LP* or in-house. However, the choice of bonus scheme targets and definitions may itself be sensitive to the R&D funding choice and explicitly incorporate the choices into the plan. Even if the bonus scheme is chosen first, the firm may *ex post* adjust the scheme to reflect the funding choice. Second, the hypothesis assumes management compensation is not implicitly linked to accounting performance in the absence of explicit bonus agreements (see Bowen, Noreen, and Lacey [1981], and also Ball and Foster [1982] and Kelly [1983] for a discussion of the construct validity of a binary compensation variable). Third, the hypothesis also assumes that the managerial labor market does not completely remove a manager's motivation to implement operating decisions which may be inconsistent with the owner's interests (in terms of Fama's [1980] model there is less than full "*ex post* setting up").

Summary

Two motivations for firms to fund R&D through an *LP* lend themselves to empirical testing. These motivations, labelled the tax motivation and the off-balance-sheet motivation, may interact as follows. A firm may exploit its debt capacity with high leverage to shield its taxable income from taxes, resulting in a low tax rate. Alternatively, a firm may be low-tax because of low profitability and its bankers may have written tight debt constraints. Further, under the tax hypothesis, *LP* firms are likely to be earning low profits, implying low dividends. These examples illustrate the difficulty of identifying cause-and-effect relationships between taxes and debt structures. Thus, caution is required in interpreting any observed univariate differences between the *LP* and in-house firms with respect to the predictor variables. This interaction motivates a multivariate regression approach.

III. Experimental Design and Sample Selection

Tests are conducted in a cross-sectional framework by comparing the firms that have entered into limited partnerships (R&D *LP* firms) with those that conduct (fund) all their R&D in-house (in-house or control firms). R&D *LP* firms were identified by consulting the following sources: Stanger's Tax Shelter Yearbook [1983], which lists public offerings for 1982, Rudoff's Tax Shelter Directory [1982], which lists some public and private offerings made in 1981, and Stanger's Partnership Sponsor Directory [1984], which lists public offerings and some private offerings in 1983–1984. A search of the ABI/Inform, the Management Contents, and the Legal Resource Index data bases was conducted using the DIALOG Information Retrieval Service. Finally, a search of annual reports using the National Accounting Automated Retrieval Service (NAARS) data base was conducted.

Financial data were collected from various sources. In cases where the R&D sponsor firm was the general partner (i.e., did not set up a special subsidiary or associate firm), the R&D firm's financial statements were in the *LP* prospectus. Otherwise financial statement data were gathered from annual reports, 10-K's, and where necessary, supplemented by reference (if possible) to the 1984 COMPUSTAT Industrial and OTC files. These procedures resulted in a sample of 103 R&D *LP*s of which over 80 percent were identified through the NAARS search.

All firms on the 1984 COMPUSTAT Annual Industrial and OTC files with non-zero R&D expense in the same (four-digit) industry and year as an R&D *LP* firm were selected as in-house control firms. There were 755 such firms; 103 of these firms were then randomly selected (without replacement) for further scrutiny. None of the annual reports of these randomly selected firms contained references to R&D limited partnerships. Certain tests and variables (for example, the dividend covenant and management bonus scheme dummy variables) required individual searches of the annual reports, 10-K's, and proxy statements of the control firms. These variables were collected only for the random sample of 103 firms to reduce data collection costs. In the interests of conserving space, all the results (except Table 1) and discussion relate to the 103 R&D *LP* firms and 103 random sample in-house firms. All tests, where possible, were replicated using the full 755 R&D in-house firms (full results are reported in Shevlin [1986]). There was very little difference in the results and no qualitatively different interpretations between the two sets of results.[7]

Table 1 presents some details of the sample. Panel A reports the breakdown of the *LP* and in-house firms by year with most of the *LP*s occurring in the 1980–1983 period. Since most of the observations were identified through the NAARS search and many fiscal year 1984 financial statements were not on the data base at the time of the search (May 1985), relatively few *LP*'s formed in 1984 (or thereafter) were identified. Panel B classifies the *LP* and in-house

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[7] Nineteen firms entered into more than one *LP* but in different periods. Regression results for the 75 observations representing the first *LP* entered into by each firm were similar to those reported below using all the 103 *LP* observations. While all the in-house firms were selected from the COMPUSTAT tapes, only 71 of the *LP* firms were on COMPUSTAT. Regression results using only these COMPUSTAT firms were also consistent with the results reported.

TABLE 1

R&D SAMPLE CLASSIFIED BY YEAR AND INDUSTRY COMPOSITION

Panel A: R&D sample classified by latest fiscal year prior to formation of LP

		R&D in-house firms	
Year	*R&D* LP *firms*	*Random Sample*	*Full*
1975	1	1	10
76	0	0	0
77	2	2	17
78	3	2	15
79	5	9	56
80	10	8	58
81	22	15	146
82	31	34	242
83	25	27	181
84	4	5	30
	103	103	755

Panel B: R&D LP *industry composition*

			R&D in-house firms	
Industry name	*Code*	*R&D* LP *firms*	*Random Sample*	*Full*
Books: publishing & printing	2731	1	1	4
Drugs	2830	6	4	49
Fabricated metal products NEC	3499	1	1	11
Special industry machinery	3550	1	2	16
Pollution control machinery	3558	1		2
Office computing & accg. machines	3570	5	7	24
Electric & elec. machinery equip.	3600	1	2	6
Electrical industrial apparatus	3620	1	2	9
Radio—TV receiving sets	3651	1		13
Radio—TV transmitting equip.	3662	5	16	124
Semiconductors & related devices	3674	2	3	24
Electronic components NEC	3679	3	10	73
Electronic computing equip.	3680	1		9
Computers—mini & micro	3681	2	8	40
Computer terminals	3683	1	1	13
Computer disk & tape drives	3684	4	1	15
Computer graphic systems	3686	3	5	27
Computer peripherals	3688	1		6
X-ray electromedical apparatus	3693	3		15
Motor vehicles & car bodies	3711	1	1	7
Industrial measurement instrument	3823	6	9	54
Optical instruments & lenses	3830	1	3	4
Surgical & medical instruments	3841	9	6	87
Ortho.-prosth.-surgical appliances	3842	4	1	4
Misc. manufacturing industries	3990	2	1	12
Patent owners & lessors	6794	2		2
Services: computer software	7372	7	7	48
Services: data processing services	7374	1	1	6
Services: R&D laboratories	7391	20	8	28
Services: business services NEC	7399	7	3	23
		103	103	755

firms by industry. The R&D *LP* firms are mostly in the drugs, pharmaceutical (including biotechnology), medical, electronic, and computer (high technology) industries. Examination of the 20 observations in SIC 7391 (Services: R&D laboratories) indicates that many of these firms were not simply service laboratories but full-fledged companies conducting R&D on their own account (as well as possibly on contract for clients). These firms were mostly in the industries listed above.

Measurement of Predictor Variables

The predictor variables are the corporate marginal tax rate (tax), leverage (lev), interest coverage (intcov), and dummy variables for the existence of a dividend covenant (divcov) and a management bonus plan defined in terms of accounting earnings (mcomp). When estimating ratio variables, negative ratios (negative equity in the leverage ratio, negative income in the interest coverage ratio) are set to zero. To avoid the effects of outliers dominating the regression estimates, firms with leverage ratios greater than five are reset to five and interest coverage ratios greater than 100 are reset to 100 (further details are reported in the next section). The interest coverage ratios of firms with zero interest expense are reset to 100 (maximum coverage) provided net income is positive. The sensitivity of the results to these adjustments is discussed below.

The marginal tax rate variable requires further discussion. The relevant theoretical marginal tax rate is the present value of the future cash flow paid to the tax authorities as a result of earning one extra dollar of income. A simple example illustrates this idea. Assume a firm reports a $100,000 tax loss in period zero and that it cannot carry back this loss. This gives rise to a net operating loss carryforward (NOL c/f) of $100,000.[8] Thus, it would appear that an extra dollar of income is not taxed. However, suppose in period 1 the firm earns $250,000 which is taxed at the .46 statutory marginal tax rate. The $100,000 NOL deduction is carried forward against this taxable income so that the tax payable in period 1 is $69,000 ([250,000 − 100,000] times .46). The tax payable in period 1 from earning an extra dollar in period zero is 46 cents. Assuming an after-tax discount rate of ten percent, the present value of this marginal tax is $(.46/1.10) = .4182 = \tau_0^m$. Actually, .4182 represents an upper bound on the marginal tax rate in this example. The tax rate will be less if the probability of a future negative taxable income realization giving rise to a carryback is positive.

This example also illustrates that in the absence of implicit taxes (defined below), investment tax credits, add-on minimum tax, and other special credits and deductions, the marginal tax rate of a firm that earns a taxable income greater than $100,000 in every period will equal the maximum statutory marginal tax rate in that period. Due to the possibility of tax-loss carrybacks, the marginal tax rate will be less than the maximum statutory marginal rate for firms that face a nonzero probability of a negative taxable income in the future.

The marginal corporate tax rate is defined above with respect to the cash flow to the taxing authorities. However, this definition does not explicitly incorporate implicit taxes. Investors face smaller equilibrium pre-tax returns on tax-favored assets than on fully taxable assets of similar risk. The difference in equilibrium pre-tax returns defines the implicit tax, or in other words, it is the amount the investor pays in lieu of taxes to purchase the tax benefit the investment offers. The theoretical definition of the marginal tax rate is expanded to include implicit taxes and this further complicates marginal tax rate calculations.[9]

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[8] Firms may elect to either carryback or carryforward the NOL (under Section 172 of the IRC). Given the time value of money and the uncertainties surrounding future profits, the tax benefits of an NOL will usually be greater if the company can carryback the loss.

Three different approaches to estimating the tax rate variable are examined: the conventional effective tax rate approach, a simulation approach, and an instrumental variables approach based on the Scholes and Wolfson [1984] tax status model.

Effective Tax Rate Approach

The conventional concept of effective tax rate, as measured by tax payable divided by taxable income, differs from the theoretical measure in two major respects.[10] First, the theoretical measure is concerned with the multiperiod effects of taxes on cash flows, and second, it is a marginal rate, not an average rate (see Fullerton [1983]). For firms with low taxable incomes, the U.S. Federal corporate tax rate is progressive. Only income above $100,000 is taxed at the 46 percent top marginal rate. The effective tax rate is included as a benchmark because it is sometimes used in the accounting literature (e.g., see Zimmerman [1983]).

Simulated Marginal Tax Rate Approach

The second approach to estimating the corporate marginal tax rate for each firm is to simulate the present value of the change in tax payable as a result of earning one extra dollar. This requires knowledge of the amount and state-contingent timing of the tax payments (savings) to which this extra dollar gives rise. In other words, a probability distribution over the firm's future taxable income is required. For this purpose, taxable income is assumed to follow a random walk process with the error term (changes in taxable income) normally distributed. Even with these assumptions, it is not possible analytically to solve for the firm's marginal tax rate. The rate depends not only on the amount of future taxable income but its time path (or sequence) given the tax code provisions allowing a three-year carryback and 15-year carryforward of tax losses. Tax payments in any particular year depend on the sequence of income over the surrounding 18 years. Thus numerical (simulation) methods are required to estimate the marginal tax rate.

The estimation procedure uses the firm's reported taxable income and NOL positions in each period up to period zero and the simulated taxable income series for $0<t\leq 18$. Future taxable income observations are generated using $TI_{jt}=TI_{jt-1}+\epsilon_{jt}$ where ϵ_{jt} represents the change in the taxable income series from period to period. Realizations of ϵ_{jt} for $t>0$ are simulated by generating a normally distributed random variable (with mean $\overline{\Delta TI_j}$ and variance $\sigma_j^2(\Delta TI)$). Given these data, a tax payable series is estimated using the tax code NOL rules and the statutory rates applicable in period zero. Next, one dollar is added to the period zero taxable income realization, the tax payable series is reestimated, and the present value of the differences in the tax payable series calculated. This procedure is repeated 50 times to provide different realizations of the random walk time path of the taxable income series. The marginal tax rate is estimated as the average of the present values obtained in the 50 repetitions.

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[9] The following example highlights the need to include implicit taxes in the definition. Suppose a firm invests its entire capital of $1,000 in ten percent fully taxable bonds. Tax payable (at 46 percent assuming proportionality) on the income of $100 is $46. If an identical firm instead invested in tax-exempt six percent municipal bonds, its income is $60 with no explicit corporate income tax payment. The implicit tax on the municipal bond is 40 percent (=(10% −6%)/10%). The firm's (theoretical) marginal tax rate is not zero but 40 percent, which equals the implicit tax.

[10] In the absence of access to corporate tax returns, reported accounting numbers must be used to infer the relevant tax variables. Tax payable is defined as tax expense less the change in the deferred tax account. Pretax income is defined as reported income less the change in the deferred tax account grossed up by the statutory marginal tax rate.

Various assumptions are required in estimating the simulated marginal tax rates. Results are reported assuming taxable income follows a random walk (with drift) process with normally distributed error terms, no bankruptcy, and a ten percent after-tax discount rate. The parameters of the taxable income model for firms with insufficient past observations are set to the means estimated using all remaining firms.[11]

Instrumental Variables Approach

Scholes and Wolfson [1984] argue that correctly estimating a firm's marginal tax rate is further complicated by the existence of implicit taxes. For example, as shown earlier, for purchasers of tax-favored assets, the conventional effective tax rate measure (tax payable/taxable income) understates both marginal and average tax rates. However, as previously noted, tax payable and taxable income are not directly observable and estimates must be derived from book (or accounting) numbers. These estimates are derived by adjusting for the change in the deferred tax account. This adjustment reflects timing differences; permanent differences such as nontaxable income and nontax-deductible expenses (e.g., amortization of goodwill) are still included in the estimated taxable income. Therefore, using estimated taxable income reduces, to some extent, the measurement error in the effective and simulated marginal tax rates.[12]

In econometric terms, the above argument is that there is a measurement error in the predictor variable marginal tax rate (measured either by the effective or simulated tax rate).[13] The classical

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[11] Sensitivity of the estimates and results to these assumptions is examined in Shevlin [1986]. The results were generally consistent across the different simulation scenarios. These scenarios included variations in the after-tax discount rate, in bankruptcy assumptions, in the treatment of firms with missing values, and assuming taxable income follows a mean-reverting process. Further, the simulation assumes the taxable income stream is exogenous. That is, it does not capture the effect on taxable income of current and future management actions with respect to tax-motivated investment and financing decisions. In a first-best experiment, the endogenous nature of future taxable income outcomes would be incorporated into the analysis. However, tax planning by firms involves a complex optimization program which is firm-specific and therefore difficult to simulate. To examine the sensitivity of the simulated marginal tax rates to the assumption of exogenous taxable income flows, a simulation run was conducted allowing for some endogenous choice by management. The simulation was conducted assuming managers can "peek" one period ahead (from period zero) to period one. If the firm will be in an NOL carryforward position at the end of period one, the firm is assumed, in period zero, to issue equity equal to 30 percent of its total assets and invest this money in fully taxable bonds earning ten percent interest with the investment held for five years. This (simple) assumption reflects one option available to an NOL firm to capture the tax benefits of deductions, is relatively easy to implement, and captures the idea of endogeneity of current tax rates. The results using this one-period-ahead tax strategy were similar to those reported below.

[12] Further, if implicit taxes and nontax-deductible expenses are not correlated with tax status, then the measurement error in the estimates of marginal tax rates is similar across all firms. However, both may be correlated with tax status in this study. Goodwill is acquired through acquisitions and it is unlikely that *LP* firms (young start-ups) will have much goodwill, if any, recorded in their accounts. It is more likely that the in-house firms may have some recorded goodwill and this may lead to understatement of these firms' marginal tax rates. Nontaxable income (arising from tax-favored assets) is likely to be higher for high-tax-status firms using tax clientele arguments (e.g., see Scholes and Wolfson [1984]) than for low-tax-status firms. Thus, marginal tax rates are likely to be relatively more understated for high-tax firms than for low-tax firms. These high-tax firms are predicted to be the in-house firms, and this understatement (together with the possible amortization understatement) biases the tests against rejection of the tax hypothesis and further motivates the use of an instrumental variable approach.

[13] Note, however, while it is argued here that the effective tax rates measure marginal tax rates with error, if firms base their *LP* decision on effective tax rates, because they are simpler to estimate than marginal tax rates, then the effective tax rate is the appropriate measure to use in the hypothesis tests. See Johnston [1984, p. 434] for a discussion of this idea.

TABLE 2

REGRESSION COEFFICIENTS ON INSTRUMENTAL VARIABLES USED FOR ESTIMATING CORPORATE MARGINAL TAX RATES

		Dependent variable in model				
		Effective tax rate		*Simulated tax rate*		
Instruments	*Predicted Sign*	*Coefficient*	*t-statistic*	*Coefficient*	*t-statistic*	*Auxiliary R-squared*
Management compensation						
Incentive stock option (ISO)	−	0.011	0.246	−0.033	−1.288	0.109
Interest free loan	−	0.050	0.359	0.055	0.667	0.392
Defined benefit pension	+	−0.017	−0.299	0.032	0.932	0.362
Non-qualified option (NQO)	+	−0.042	−0.971	0.031	1.254	0.169
Financing						
Preferred stock	−	2.636	5.418	0.096	0.451	0.423
Convertibles	−	−1.671	−3.036	−0.168	−0.851	0.320
Common equity	−	0.432	3.057	0.056	0.864	0.964
Operating leases	−	0.036	0.259	−0.108	−1.465	0.501
Secured debt	+	−0.557	−1.393	−0.605	−2.805	0.268
Straight debt	+	−0.116	−0.455	−0.147	−1.101	0.330
Other						
R&D/sales	+	−0.218	−1.404	−0.228	−3.319	0.347
Ln (No. of years operating)	+	0.027	0.806	−0.005	−0.273	0.377
Inventory valuation method	−	−0.018	−0.408	−0.002	−0.078	0.281
Net operating loss carry-forward (NOL cf)	−	−0.855	−3.409	−0.040	−0.791	0.829
Retained earnings/total assets (RE/TA)	+	0.354	2.537	0.110	1.654	0.969
Change in taxable income (ΔTI)	+	−0.001	−0.410	0.000	0.256	0.737
SD(ΔTI)	+	0.002	1.230	0.000	0.208	0.755

Notes: 1. The model with the effective tax rate as the dependent variable is estimated using single-limit tobit and the model with the simulated tax rate as the dependent variable is estimated using two-limit tobit. The model coefficients are estimated using firms with complete data series:—51 R&D *LP* firms and 81 in-house control firms ($N=132$). All the financing variables are deflated by total assets (TA). The ISO, interest free loan, defined benefit plan, and NQO dummy variables coded one if they exist, zero otherwise. Inventory valuation method coded one for FIFO, zero for LIFO.

2. The auxiliary *R*-squared for each variable is estimated by OLS regression of the named variable on all the remaining instrumental variables and is the multiple correlation coefficient.

approach, given the existence of measurement error in a predictor variable, is to use an instrumental variables approach which is implemented here in a two-stage procedure. The first stage regresses the variable measured with error (corporate tax rates) on the instrumental variables. The fitted values of the dependent variable are then used in the second stage as the estimate of the firm's marginal tax rate. The analysis by Scholes and Wolfson [1984] suggests variables that may be used as instruments. Unfortunately, data on some of the variables are not disclosed in annual reports, 10-K's, or other publicly available data sources. Thus, the investment and merger variables suggested by Scholes and Wolfson are omitted from the instrument list.

The variables used as instruments are listed in Table 2. Low-tax firms are more likely to have NOL carryforwards, negative or lower retained earnings, and to use FIFO rather than LIFO inventory valuation procedures. LIFO is preferred by high-tax firms when prices are rising because it increases cost of goods sold and reduces taxable income. *Ceteris paribus*, younger firms and start-ups are likely to have lower tax rates than older, mature firms. Not all firms have a complete series of observations on all the instruments. The first stage of the approach uses only firms with complete series ($N=132$, composed of 51 *LP* and 81 in-house firms). For the 74 firms with missing values, the tax-rate estimate is derived by multiplying the first stage coefficients (estimated on the sample of 132 firms) by the vector of instrumental variables (excluding any elements of the vector that are missing).[14]

Coefficient estimates (using tobit) in the first stage of the approach are reported in Table 2. There are two sets of coefficient estimates corresponding to the use of effective tax rates and simulated tax rates as the dependent variable in the first stage of the two-stage approach. The fitted values of the tax-rate measure are constrained to lie in the interval [zero, .46]. The predicted sign of each coefficient and the t-value of the coefficient are also included in Table 2 for illustration only. The arguments underlying the selection of instrumental variables suggest that these variables should be highly correlated, and given the auxiliary R squares reported in Table 2, care should be exercised in interpreting the coefficient estimates and t-statistics in the presence of multicollinearity.

LP/TI Tax Variable

An alternative to the marginal tax-rate variable to capture the tax motivation is the size of the *LP* (i.e., the dollar amount raised through the *LP*) relative to the firm's taxable income (excluding any effects of the *LP*). This ratio is motivated both by the Majd and Myers [1985] analysis and by the measurement problems associated with marginal tax rates. It is predicted that the higher the *LP/TI* ratio (a ratio greater than one implies a tax loss), the more likely it is that a firm will choose the *LP* route.

For firms conducting their R&D in-house, an estimate of the "*LP*" amount must be used. The ratio is estimated by summing the reported R&D expense for each firm over the two years following period zero.[15] This sum is then divided by the firm's period zero taxable income. However, for firms with a negative *TI* in period zero, the (negative) *LP/TI* ratio has little meaning. To avoid this problem, the ratio is set equal to the numerator for these firms (33 *LP* and 19 in-house firms). Several firms had very small (positive) taxable incomes; to avoid the problem of outliers dominating the regressions, the *LP/TI* ratio is truncated at 100 (three LP firms and one in-house firm). The sensitivity of the results to these adjustments is discussed below.

Profile and Descriptive Analysis of Sample Firms

A profile analysis is conducted to understand more fully the differences, if any, between firms conducting their R&D through an *LP* and those doing it in-house. Table 3 presents descriptive statistics on financial and predictor variables for the 103 R&D *LP* firms and 103 (random sample) R&D in-house firms and univariate significance tests. For the financial variables, two-tailed probabilities are based on the Wilcoxon rank sum test. Tests on the predictor variables use an ordered-alternatives (Jonckeheere)

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[14] An alternative approach is to set the missing values for any variable to the mean of that variable, but this results in biased estimates of the first-stage coefficients and thus of the fitted values.

[15] A two-year summation is chosen, after reading the *LP* prospectuses, as being reasonably representative of *LP* expenditure patterns. This summation also assumes that all the in-house R&D could have been funded through an *LP*.

TABLE 3

PROFILE ANALYSIS OF R&D *LP* AND IN-HOUSE CONTROL SAMPLE FIRMS

	R&D LP *sample* (N=103)				*In-house control firms* (N=103)				*Prob-abilities* LP *vs* IH
Variable	*Median*	*Mean*	*Standard Deviation*	N	*Median*	*Mean*	*Standard Deviation*	N	
Financial variables									
Net sales	15.23	134.63	534.57	102	47.55	693.99	3016.64	103	.00
Net income	.50	9.62	41.73	103	2.11	46.48	233.26	103	.00
NOL c/f	.00	3.02	9.16	92	.00	1.95	6.30	98	.00
Total assets	13.62	127.34	438.10	103	44.89	599.53	2648.84	103	.00
NC liabilities	1.58	24.42	80.68	103	5.70	98.98	383.53	103	.00
Total equity	8.59	70.97	254.37	103	23.90	301.99	1332.93	103	.00
Market capn.	53.42	219.80	590.96	77	54.06	634.65	2707.33	100	.69
R&D/sales	.09	.48	1.45	91	.05	.63	5.38	103	.00
ROA	.04	.06	.07	103	.06	.07	.06	103	.37
Dividend payout	.00	.06	.16	103	.00	.13	.27	103	.00
Years operating	11.00	12.43	11.05	95	21.00	24.41	19.58	97	.00
SD (Earnings)	1.18	6.20	21.45	93	2.55	22.10	98.14	100	.00
Var. (Returns)	.08	.09	.05	33	.06	.08	.07	45	.72
Beta	1.03	1.08	.46	33	.96	1.03	.55	45	.39
LP amount	4.20	1.21	13.79	97					
LP/TA	.24	.69	1.36	97					
LP/Market cap.	.09	.15	.18	74					
LP/Total R&D	.24	.29	.24	59					
Predictor variables									
Effective tax rate	.24	.25	.29	103	.30	.25	.19	103	<.27
Simulated tax rate	.39	.32	.17	103	.46	.37	.15	103	<.01
IV tax rate	.32	.29	.13	103	.38	.35	.11	103	<.00
LP/TI	2.63	11.79	21.97	97	1.40	3.39	10.79	103	>.00
Leverage	.21	.67	1.25	103	.24	.40	.60	103	>.37
Interest coverage	1.57	13.48	28.22	103	3.13	14.37	27.27	103	<.05
Dividend covenant	.00	.41	.49	103	.00	.46	.50	103	>.27
Management bonus plan	1.00	.63	.48	103	1.00	.61	.49	103	>.43

Notes:
1. Monetary amounts in millions of dollars.
2. Sample size (*N*) is less than 103 due to missing data for some variables.
3. Probabilities for financial variables based on Wilcoxon rank-sum test (two-tailed). Probabilities for predictor variables based on ordered alternatives (Jonckeheere) test (one-tailed with the predicted direction beside the probability). Predicted direction is *LP* vs. in-house (*IH*).
4. Negative earnings ratios reset to zero.
5. Leverage ratios greater than five reset to five.
6. Interest coverage and *LP/TI* ratios greater than 100 reset to 100.
7. Number of ratios reset:

Ratio	*LP*	*IH*
Earnings ratios	33	19
Leverage	6	1
Interest coverage	8	8
LP/TI	3	1

test. Both tests are discussed in Hollander and Wolfe [1973].

With respect to the *LP* firms, median firm size, as measured by the book value of total assets, is $13.62 million with median sales of $15.23 million. The median *LP* amount is $4.20 million, which exceeds the median non-current liabilities of $1.58 million. The median *LP/TA* ratio is 24 percent and median (*LP*/Market capitalization) is nine percent, which suggests that *LPs* represent an important source of finance to these firms.

Comparing the two sets of firms indicates that the in-house sample consists of firms that are, on average, significantly larger at the five percent level (the convention adopted in this paper of assessing significance) than the *LP* firms (where size is measured by sales, total assets, and total equity). There is no significant difference in the equity market capitalization of the listed *LP* firms and the in-house firms. Note, however, there are 26 *LP* firms for which market value data are unavailable because they are not listed. Given that these are likely to be smaller firms, the ratios using the market value of equity for the *LP* group are likely to be understated. The *LP* firms also report significantly lower net income; however, the return on the assets of the two groups is not significantly different. Over 30 percent of the *LP* firms report NOL carryforwards for tax purposes compared to ten percent of the in-house firms. The *LP* firms are also significantly younger, with 50 percent less than 11 years old compared to more than 50 percent of the in-house firms being more than 20 years old. These differences provide evidence consistent with the *LP* firms being lower-tax firms than the in-house firms.

The *LP* firms' median R&D/sales ratio (a measure of R&D intensity) is significantly higher at twice the rate of the in-house firms. There appear to be no differences in the variance of equity returns and systematic risk (market model beta) of the two groups. Again, however, data are not available for many of the smaller firms, so these results may not be representative. The standard deviation of the past earnings series is larger for the control firms, but this appears due to these firms being larger with a higher level of earnings. Overall, the profile analysis suggests the R&D firms using *LPs* are significantly smaller than the firms funding their R&D in-house.

With respect to the predictor variables, the effective tax rates are not significantly different, although the *LP* firms report a lower median while both the simulated and instrumental variable tax rates are significantly lower for the *LP* firms. The *LP/TI* tax variable is significantly higher for the *LP* firms. These differences are all consistent with the tax motivation to use an *LP* to fund R&D. The median leverage and interest coverage ratios of the *LP* group are less than those of the in-house group, with the latter being significantly less. There is no significant difference between the two sets of firms in the dummy variables representing the existence of a dividend covenant and a management compensation bonus scheme. Overall, these univariate results offer support for the tax motivation for firms to use an R&D *LP*, but only limited support for the off-balance-sheet motivation. However, in the presence of firm size differences and the interaction between taxes and debt structure, care should be used in drawing conclusions from univariate tests.

A correlation matrix is presented in Table 4. Recall, *LP* usage is defined as the binary variable $y=1$ if the R&D firm uses an *LP* and $y=0$ for the in-house firms. The correlation between the simulated and instrumental variable tax rates and *LP* usage is negative and significant (at the one-tailed five percent level) consistent with the tax hypothesis. The *LP/TI* tax variable is significantly positively correlated with *LP* usage also consistent with the tax motivation. However, the positive correlation between the effective

TABLE 4

PRODUCT MOMENT CORRELATION MATRIX FOR R&D SAMPLE FIRMS

	Variable	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
1	*Y*	1.000									
2	Eff. tax rate	.004	1.000								
3	Sim. tax rate	−.161	.379	1.000							
4	IV tax rate	−.248	.290	.615	1.000						
5	*LP/TI*	.239	−.054	−.073	−.233	1.000					
6	Leverage	.136	−.197	−.212	−.262	.079	1.000				
7	Int. coverage	−.016	.246	.274	.271	−.058	−.234	1.000			
8	Div. covenant	−.049	.025	.052	−.047	.001	.074	−.285	1.000		
9	Mgt. bonus plan	.020	.100	.178	.287	−.086	−.131	.032	.075	1.000	
10	*ln*(*TA*)	−.269	.209	.457	.429	−.087	−.202	.024	.120	.257	1.000
	Auxiliary *R*-squared	—	.096	.272	.263	.018	.098	.132	.071	.092	.212

Notes: 1. Cut-offs for five percent significance level: (N=206) $\frac{\text{two-tailed}}{|r|>0.135}$ $\frac{\text{one-tailed}}{|r|>0.114}$

2. The auxiliary *R*-squared for each variable is estimated by OLS regression of each predictor variable on all the remaining predictor variables (excluding the other tax variables) and is the multiple correlation coefficient. When estimating the statistic for each non-tax variable, the IV tax rate is used.

tax rate and *LP* usage is not consistent with the tax hypothesis but could be due to effective tax rates measuring marginal tax rates with error. Leverage is significantly positively correlated with *LP* usage, consistent with the off-balance-sheet motivation. The interest coverage, dividend covenant, and management compensation correlations with *LP* usage are not significantly different from zero, and thus do not offer support for the off-balance-sheet motivation. Firm size and *LP* usage are significantly negatively correlated; smaller firms are more likely to use an R&D *LP*. Firm size and marginal tax rates are significantly positively correlated, consistent with smaller firms with lower marginal tax rates using R&D *LP*'s. While firm size and the *LP/TI* tax variable are negatively correlated, consistent with the Majd and Myers [1985] analysis, the correlation is not significant, suggesting that this variable may reduce the collinearity problems facing the marginal tax rate variables. Firm size and the management compensation variable are significantly positively correlated, which is consistent with the separation of ownership and control in larger firms, and thus, larger firms requiring explicit compensation schemes to align the incentives of management with those of shareholders.

Data on the existence and type of restrictive covenants facing the sample firms were collected. As shown in Table 5, over half of the *LP* and in-house firms disclosed the existence of bond covenants with no significant difference in the incidence of covenants between the two groups. The most common sources of covenants for both types of firms are: (1) debenture and long-term debt agreements and (2) credit lines with banks and other financial institutions. The *LP* firms are more frequently subject to covenants from other sources, including major supplier and major shareholder-imposed covenants.

Consistent with the arguments of Smith and Warner [1979], covenants most frequently impose financing-related constraints and/or dividend restrictions. Significantly more of the *LP* firms sub-

TABLE 5
CONTINGENCY TABLES ON BOND COVENANT-RELATED VARIABLES FOR R&D *LP* AND IN-HOUSE CONTROL SAMPLE FIRMS

Variable		LP	*In-house*	Chi-*square* (*prob.*)	*Z-statistic* (*prob.*)
Subject to bond covenants	Yes	54	59	0.31	−0.55 >
	No	44	41	(0.58)	(0.71)
Source of covenant					
Debentures, bonds		31	38	6.96	NA
Credit lines		13	19	(0.03)	
Other		10	2		
Type of covenant					
Investment restrictions	Yes	12	14	0.04	−0.19 >
	No	42	45	(0.84)	(0.57)
Financing restrictions	Yes	44	39	3.42	1.85 >
	No	10	20	(0.06)	(0.03)
Dividend restrictions	Yes	42	47	0.06	−0.24 >
	No	12	12	(0.81)	(0.59)
Specific leverage	Yes	38	30	4.48	2.15 >
	No	16	29	(0.03)	(0.02)

Notes: 1. The *Z*-statistic is derived using the normal approximation for the binomial. The null hypothesis is $p1-p2=0$ where $p1$ ($p2$) is the proportion of YES responses in the *LP* (in-house) sample.
2. The predicted difference, where applicable, between the two groups is included in the rightmost column.
3. Source: Annual reports and 10-K of sample firms. Data were available for 98 *LP* firms and 100 in-house firms.

ject to constraints are subject to financing-related constraints. Further, in 86 percent (38/44) of the *LP* firms' financing constraints, the leverage ratio (or some variant, such as no further debt may be raised) is explicitly mentioned; for the in-house control firms this percentage is 77 percent (30/39). The differences in the incidence of investment restrictions and dividend restrictions between the two sets of firms are not statistically significant. Finally, six of the 54 *LP* firms with covenants reported that they were in technical default of their covenants; however, four received waivers of default. Six of the 59 in-house firms reported that they were in default, with two receiving waivers.

Overall, these results suggest the operationalization of the off-balance-sheet motivations through bond covenant/contracting cost arguments is reasonable, with over half of the *LP* firms subject to covenants. While more in-house firms are subject to covenants than *LP* firms, relatively more of the *LP* firms are subject to financing-related constraints consistent with the use of the leverage and interest coverage ratio variables to represent the off-balance-sheet motivation. However, the results for the dividend covenant variable offer little support for the off-balance-sheet motivation.[16]

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[16] These data were gathered from disclosures in the notes to the annual reports. To the extent that firms did not disclose the existence of bond covenants, these numbers are understated. Further, these results do not imply that both groups are similarly affected by the covenants. This requires explicit knowledge of the terms of

IV. EMPIRICAL RESULTS

The profile analysis in the preceding section indicates that the *LP* firms are significantly smaller than the in-house firms. Univariate analyses ignore this difference as well as any correlations between the predictor variables. In an attempt to control for the former problem, firm size is included as a separate variable (covariate) in a multivariate regression model, and the multivariate tests then examine if the marginal tax rate and off-balance-sheet variables have incremental explanatory power in addition to firm size and to each other. With respect to the latter problem, the variables used to operationalize the off-balance-sheet motivation are correlated (as reported in Table 4), and it is necessary to consider the joint effects of these variables.

The model to be estimated is

$$y_i = b_0 + b_1 ln(TA_i) + b_2 tax_i + b_3 lev_i + b_4 intcov_i + b_5 divcov_i + b_6 mcomp_i + u_i$$

where $y_i = 1$ if the firm uses an *LP* and zero otherwise.[17] The logit model is used to estimate the regression model given that the dependent variable is defined in binary form.[18] The coefficients b_1, b_2, and b_4 are predicted to be negative, while b_3, b_5, and b_6 are predicted to be positive. When the *LP/TI* tax variable is substituted for the marginal tax rate variable, b_2 is predicted to be positive.

Multivariate Logit Regression Results

Regression results are reported in Table 6 for each measure of the tax variable.[19] The predicted sign of each of the coefficients is also included in the table. Note that the sign on the coefficient on the *LP/TI* tax variable is predicted to be positive. The firm size variable is negative and significant in each regression (as expected given the results from the profile analysis). With respect to the tax measures, the coefficient on the effective tax rate is positive (but not significant), while the coefficients on the simulated and instrumental variable tax measures are negative, with the latter being significant.

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the covenants to assess each firm's proximity to their covenants.

[17] Firm size is measured by the natural log of total assets $ln(TA)$ to reduce both the skewness and kurtosis in the distribution of total assets. Further note that a binary dependent variable ignores any information on the size (dollar magnitude) of the *LP* relative to the size of the firm and, in an attempt to capture this information, the dependent variable was also defined in ratio form. In the absence of any well-defined theoretical definition, several ratio definitions were examined: (*LP* amount/(Total assets+*LP* amount)), (*LP* amount/Equity market capitalization), and (*LP* amount/Total R&D of the firm) (representing the percentage of the firm's total R&D funded by the limited partnership in the two years following the formation of the *LP*). The latter two definitions resulted in firms with missing values, substantially reducing the sample sizes (as reported in Table 3). The regression results and interpretations using the ratio definitions are qualitatively similar to those reported using the binary variable. Note that when the dependent variable is defined in ratio form, it is bounded below by zero and tobit is the appropriate multivariate estimation procedure (see Maddala [1983]).

[18] See Amemiya [1981] for a discussion of the problems with OLS in this framework. Alternative estimation procedures are logit and probit. Note that both logit and probit are more than just estimation techniques in that they imply characterizations of a decision process (see Amemiya [1981]). Estimation using probit gave similar results to the reported logit results. Noreen [1986] provides simulation evidence that OLS may be better specified than probit using accounting data similar to the variables studied here. Daley and Vigeland [1983], in their study of the choice by firms whether to expense or capitalize R&D, use a generalized jackknife procedure. Given that the major concern with the linear probability model is one of efficiency, the jackknife and bootstrap procedures applied to the linear probability model may alleviate this concern. Thus, the model was also estimated using jackknifing, bootstrapping, and OLS estimation with little difference in the results reported below.

[19] Conventional *R*-squareds are not reported in the tables because they are not appropriate for nonlinear regression models. Amemiya [1981] and Maddala [1983] discuss *R*-squared alternatives. For the logit results in Table 6 the Maddala *R*-squared, Cragg-Uhler *R*-squared, and McFadden *R*-squared (see Maddala [1983, p. 40]) are between 0.07 and 0.25.

TABLE 6

MULTIVARIATE (LOGIT) REGRESSION RESULTS

The regression model is $y = b_0 + b_1\, ln(TA) + b_2\, tax + b_3\, lev + b_4\, intcov + b_5\, divcov + b_6\, mcomp + u$ where $y = 1$ if *LP* firm, $y = 0$ otherwise. $N = 206$ (103 *LP* firms and 103 in-house firms).

Variable *Predicted sign*	*Con-stant*	ln(TA) −	*Tax* −	*Lever-age* +	*Intcov* −	*Divcov* +	*Mcomp* +	*Chi-square*	*Percent Classified Correctly*	*Incre-mental Chi-square*
Effective tax rate										
Coefficient	0.650	−0.332	0.785	0.273	−0.003	−0.183	0.437	21.232	63.11	4.76
(t-statistic)	(1.630)	(−3.700)	(1.124)	(1.403)	(−0.522)	(−0.584)	(1.388)	($p<.01$)	($p<.001$)	($p=.313$)
Simulated tax rate										
Coefficient	0.834	−0.297	−0.466	0.247	−0.001	−0.146	0.473	20.011	63.11	4.08
(t-statistic)	(1.906)	(−3.105)	(−0.426)	(1.274)	(−0.118)	(−0.467)	(1.501)	($p<.01$)	($p<.001$)	($p=.395$)
Instrumental tax rate										
Coefficient	1.520	−0.241	−3.440	0.204	0.001	−0.201	0.630	25.394	65.53	5.00
(t-statistic)	(2.852)	(−2.587)	(−2.274)	(1.023)	(0.203)	(−0.636)	(1.920)	($p<.001$)	($p<.001$)	($p=.287$)
LP/TI tax variable (with predicted positive coefficient)										
Coefficient	0.332	−0.352	0.050	0.181	0.001	−0.094	0.712	33.991	67.50	5.24
(t-statistic)	(0.778)	(−3.662)	(2.670)	(0.872)	(0.175)	(−0.285)	(2.118)	($p<.001$)	($p<.001$)	($p=.264$)
Omitting tax variable										
Coefficient	0.750	−0.314		0.253	−0.001	−0.158	0.460	19.826	65.05	4.22
(t-statistic)	(1.924)	(−3.581)		(1.308)	(−0.250)	(−0.508)	(1.471)	($p<.01$)	($p<.001$)	($p=.377$)

Notes: 1. The first line reports the coefficient estimates and the second line the associated asymptotic t-statistics.

	Cut-offs for t-distribution	
	0.05	*0.01*
one-tail	1.645	2.326
two-tail	1.960	2.576

2. The chi-square statistic is based on the likelihood ratio test. It tests the null hypothesis that all the coefficients (except the constant) are zero. It is significant at less than the one percent level for all models above.
3. The probability on the percent classified correctly is based on a Z-statistic derived using the normal (large sample) approximation for the binomial. The null hypothesis is no difference between the logit model classification rate and a naive (or random) assignment. The null is rejected at less than the one percent level for all models above.
4. The incremental chi-square statistic tests the null hypothesis that all the coefficients on the off-balance-sheet variables (leverage, interest coverage, dividend covenant, and mcomp) are zero. The null is not rejected at the five percent level in any model above.

The coefficient on the *LP/TI* tax variable is positive and significant. The significant results for the instrumental variable marginal tax rate and the *LP/TI* tax variable provide evidence consistent with the tax motivation. The result for the effective tax rate may be interpreted to be consistent with measurement error in this variable. The result for the simulated tax rate measure suggests that while this measure more fully captures the multiperiod and marginal aspects of the marginal tax rate concept than the effective tax rate measure, it may still be subject to some measurement error which is removed through the instrumental variable approach.[20]

Significance test results on the coefficients of each of the off-balance-sheet variables offer mixed support for this motivation. The coefficient on the leverage ratio is positive (in each regression) but not significantly different from zero. The management bonus plan variable is significant in the predicted direction in two of the regressions (and is positive in the remaining three regressions). The coefficients on the interest coverage and dividend covenant variables switch sign across regressions but are not significant. However, the off-balance-sheet variables are expected to be correlated under the off-balance-sheet motivation (which they are, as reported in Table 4), so a test of their joint explanatory ability is required. This is assessed by the incremental chi-square statistic reported in Table 6, which is based on the likelihood ratio test presented in Judge et al. [1985, section 6.6.2c]. The test statistic is distributed chi-square with q degrees of freedom where q is the number of restrictions in the restricted model. The incremental chi-square test results indicate that the off-balance-sheet variables do not add incremental explanatory power either to the logit model with just firm size ($\chi^2=4.22$, $p=.377$) or to the models with firm size and taxes ($\chi^2\leq 5.24$, $p\geq .264$).

Overall, these results indicate that the tax variable adds incremental explanatory power to the logit model with firm size and thus offer support to the hypothesized tax motivation. The results do not support the off-balance-sheet motivation (except for the management compensation variable) to use an R&D *LP*.[21,22]

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[20] An alternative explanation is that the instrumental variable tax measure may also be picking up some of the off-balance-sheet explanatory power because of the inclusion of financing-related variables in the instrument list. To provide evidence on this, the instrumental variable tax measure was re-estimated, excluding the financing variables and the regressions re-estimated. Although the magnitude of the instrumental variable tax coefficient estimate was reduced, the significance level of the measure was unchanged. This supports the instrumental variable tax rate reflecting the tax motivation and supports the conclusion that the corporate marginal tax rate variable has significant incremental explanatory power over and above firm size. Further, regressions (not reported) using an instrumental variable approach with the effective tax rate as the dependent variable in the first stage (recall Table 2 reports these first-stage coefficients) suggest that the instrumental variable procedure is not successful in fully removing the measurement error in the effective tax rate.

[21] Recall that a truncation rule was adopted to avoid small denominators giving rise to misleading inferences in the regressions. The regressions were rerun (a) excluding those firms in which the leverage and/or interest coverage ratios were truncated, (b) truncating the interest coverage and *LP/TI* ratios at five instead of 100, and (c) omitting firms with negative taxable incomes in period zero. The results under these three different approaches were generally similar to those reported in Table 6 with the exception that under each approach the simulated tax rate variable was significant in the predicted direction. The results, with the noted exception, therefore do not appear sensitive to the truncation rules adopted.

[22] There were several major tax changes introduced in the Tax Acts of 1981 and 1982, with the major one being a reduction in the top personal tax rate from 70 percent to 50 percent. The wide spread between the top corporate rate (46 percent) and the top personal rate (70 percent) prior to 1982 may have led R&D firms with high marginal tax rates to use an *LP* during this period so as to get the R&D deduction in the "hands" of entities taxed at 70 percent. With the narrowing of the top rates between corporations and individuals in the post-1981 period, these high-tax firms may be less tax-motivated (the tax advantages are reduced) and there may be larger differences in rates between the *LP* and in-house firms. Therefore, in cross-sectional tests focusing on corporate marginal tax

As-If Measures of the Predictor Variables

In the regression tests above, the predictor variables are estimated at the end of the latest fiscal year prior to the *LP*'s formation. That is, the variables are calculated excluding (or prior to) the effects of the *LP* funding choice. This is consistent with most prior studies of accounting method choice. However, it is possible that firms choose the *LP* route to avoid reductions in taxable income and/or covenant violations that might arise if the R&D were funded in-house. In this scenario, the appropriate comparison is between the variables measured as if the *LP* were actually funded in-house. The empirical tests using the period-zero variables will be biased against rejection of the null hypothesis in this as-if scenario.

The bias in the marginal tax rate tests may be illustrated by a simple example. A firm with an expected taxable income of $100,000 for the foreseeable future (before the R&D project) may be considered to have a marginal tax rate close to 46 percent. Now an R&D project may require a $1 million expenditure over the next two years. Given the tax deductibility of this expenditure, the firm's taxable income in the next two years will be −$400,000 and may be expected to increase in succeeding years as a result of the project. Thus the firm's marginal tax rate would be (substantially) reduced if the R&D project were to be funded in-house. The reduction depends on both the magnitude and timing of the expected payoffs to the project. For the sample of 64 *LP* R&D firms with positive taxable incomes in period zero, the median *LP/TI* ratio is 2.37. For over 70 percent of the 64 *LP* firms, *LP/TI*>1, indicating that the *LP* amount, if deducted as in-house R&D in this year, may have put these firms in a tax loss position. This indicates that the R&D project, if funded in-house, would lead to a substantial decrease in income and thus in marginal tax rates consistent with the tax motivation to use an R&D *LP*.[23] Thus, using the current period's marginal tax rate, ignoring the effects of the R&D project, overstates the firm's marginal tax rate, and the tests using the current period tax rate estimates are biased against rejecting the tax hypothesis.

With respect to the other predictor variables, the interest coverage ratio may be overstated for the *LP* firms using period zero data because reported profits would be lower (*ceteris paribus*) under in-house than *LP* funding due to the R&D expense. This biases the tests against the interest coverage hypothesis. With respect to the leverage ratio, if the R&D were to be funded in-house, the firm may issue debt (lowering the leverage ratio), equity (increasing the ratio), or a mixture of debt and equity. Under the off-balance-sheet motivation, the firm is hypothesized to use the *LP* to avoid issuing further debt. If this is the case, using the period zero leverage ratio understates the firm's leverage ratio that would result if the R&D project were

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rates, the corporate tax-rate variable may be more significant in the post-1981 period than in the earlier period. The other changes in the Tax Act also are consistent with this prediction. To examine this prediction, the sample was partitioned into pre-1982 and post-1981 groups and the logit regressions estimated for each group. The tax variable is found to be more significant in the post-1981 period. Note, however, this does not mean that the tax motivation was not as strong in the pre-1982 period but rather that cross-sectional tests focusing only on the variation in the marginal tax rates of R&D firms are not a powerful test of the tax motivation in this period given the wide spread between the top corporate and personal tax rates.

[23] It also offers strong support for the Majd and Myers [1985] analysis which motivated the analysis of the *LP/TI* ratio. Note, however, the full *LP* amount is unlikely to be deducted in a single period and this calculation probably overstates the relevant *LP/TI* ratio.

funded in-house using all debt. The dividend covenant and management bonus plan variables, being binary variables, are "correctly dated" at period zero (although, as previously noted, they are both proxies).

To examine the effects of as-if measurement, taxes, leverage, and interest coverage are re-estimated as if the *LP* were funded in-house under two different assumptions: (a) using all debt and (b) raising capital using the existing debt mix at period zero. The all-debt assumption is consistent with the R&D firms using an *LP* to avoid increasing the debt/equity ratio. Assumption (b) provides a check on any biases from assuming all-debt funding. Under both assumptions, net income and taxable income are lower by the amount of the R&D deduction (assumed to be taken 50 percent in period 1 and 50 percent in period 2 consistent with the average *LP* deduction period) and the added interest expense arising from issuing debt.[24] In estimating the as-if (simulated) marginal tax rate, payoff distributions to the R&D are simulated over the succeeding ten years (with assumed pay-off rates of zero to 50 percent in increments of ten percent with each rate equally probable in a given simulation).

The means of the as-if measures are presented in panel A of Table 7. For comparison, the period zero measures are also reported. The as-if simulated tax measures result in lower estimates of the marginal tax rate; the as-if all-debt leverage ratio increases while, by construction, the leverage ratio using the same debt mix is the same as the period zero measure. The as-if interest coverage ratios are decreased. Each of these changes is in the direction consistent with the hypotheses which is due, in part, to the debt assumptions used in constructing the variables.

Logit regression results are presented in panel B of Table 7. With as-if funding using all debt, both the leverage and interest coverage variables have significant coefficients in the direction predicted by the off-balance-sheet motivation. The coefficient on the dividend covenant variable has the wrong sign while the management bonus variable continues to be significant in the predicted direction. The incremental chi-square indicates the as-if off-balance-sheet variables have significant incremental explanatory ability. Surprisingly, the coefficient on the as-if simulated tax variable is positive even though the rates for the *LP* firms are substantially reduced. This might be due to collinearity problems among the predictor variables as the auxiliary R-square between the as-if simulated tax rate and the other as-if predictor variables is .34. In a regression including only the as-if simulated tax measure (in addition to the firm-size variable), the tax measure exhibits a significant negative coefficient, but when the off-balance-sheet variables are added to the model, the significance of this tax measure is eliminated. With as-if funding using the existing debt/equity mix, the coefficient on the leverage ratio is positive but not significant while the simulated tax and interest coverage ratios are significant in the predicted directions.

These regression results are generally consistent with both the tax and off-balance-sheet hypotheses. A comparison of the as-if results with those reported in Table 6 (using period zero measures)

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[24] Interest expense is computed using market interest rates prevailing in the year in which the *LP* is formed. The series used is the All Industries Corporate Bonds published by the Federal Reserve Bulletin. These rates may understate the risk premium demanded by lenders to R&D firms. This in turn may overstate the interest coverage ratio for the *LP* firms, which biases the test towards the null hypothesis. Note further, six *LP* firms are omitted because the *LP* amount is not available.

TABLE 7

AS-IF MEASUREMENT OF *LP* PREDICTOR VARIABLES UNIVARIATE COMPARISONS AND REGRESSION RESULTS

Panel A: Univariate descriptive data-means

	R&D LP *firms* (N=97)			*In-house firms* (N=103)
	As-if			
	All debt	*Same debt mix*	*Period 0*	*Period 0*
Simulated tax	0.25	0.26	0.33	0.37
Leverage	1.42	0.59	0.59	0.40
Int. coverage	0.46	5.21	14.17	14.37

***Panel B:* *Logit regression results* (y=1 if *LP* firm (N=97), y=0 otherwise (N=103))**
(The regression model is $y=b_0+b_1\ ln(TA)+b_2\ tax+b_3\ lev+b_4\ intcov+b_5\ divcov+b_6\ mcomp+u$)

Variable *Predicted sign*	*Con-stant*	ln(TA) −	*Sim Tax* −	*Lever-age* +	*Intcov* −	*Divcov* +	*Mcomp* +	*Chi-square*	*Percent Classified Correctly*	*Incre-mental Chi-square*
As if funding all debt										
Coefficient	0.015	−0.141	1.271	0.783	−0.512	−0.650	0.993	103.416	77.50	76.778
(t-statistic)	(0.027)	(−1.208)	(1.023)	(2.722)	(−3.687)	(−1.699)	(2.411)	(p<.001)	(p<.001)	(p<.001)
As if funding using same debt mix										
Coefficient	1.338	−0.228	−2.623	0.097	−0.013	−0.242	0.628	34.252	67.00	7.620
(t-statistic)	(3.117)	(−2.330)	(−2.516)	(0.506)	(−1.690)	(−0.749)	(1.834)	(p<.001)	(p<.001)	(p=.106)
Omitting off-balance-sheet variables										
Coefficient	1.570	−0.186	−3.150					26.635	66.50	—
(t-statistic)	(4.184)	(−1.979)	(−3.216)					(p<.001)	(p<.001)	—

See notes to Table 6.

indicates stronger support for the off-balance-sheet motivation using as-if measures with the as-if all-debt leverage and as-if interest coverage ratios significant. The results on the leverage variable using the period zero debt/equity mix suggest that the significance of this variable may lie between those reported in Tables 6 and 7.

V. SUMMARY

This paper uses extant capital structure theories and agency models to derive hypotheses to examine the R&D funding choice. Both tax and off-balance-sheet motivations are reduced to empirically testable hypotheses which are tested on a sample of 103 R&D firms using limited partnerships and 103 firms that funded their R&D in-house.

With respect to the tax motivation, a univariate profile analysis indicates the sample of *LP* firms is, on average, significantly younger, smaller, and less profitable, with more net operating loss carryforwards, than the in-house firms. These differences are consistent with the arguments in Scholes and Wolfson [1984, p. 32] that "We would expect emerging companies, with little current taxable income, to sell tax benefits to other more highly taxed corporations." The significant size differences between the *LP* and in-house firms motivate the inclusion of a firm-size variable in a multivariate regression model to control for this difference.[25] The analysis predicts that low marginal tax rate firms are more likely than high marginal tax rate firms to fund their R&D through limited partnerships. This prediction is supported in multiple regression tests, although the result is sensitive to the measurement of corporate marginal tax rates. An alternative tax variable (*LP/TI*), which avoids some of the measurement problems associated with a marginal tax rate variable, is also found to be significant.

The empirical results with respect to the off-balance-sheet motivation are mixed. There may be various explanations. First, the results may be due to an inappropriate analysis of the off-balance-sheet motivation using contracting cost arguments. However, an analysis of the existence and types of covenants facing the sample firms supports operationalizing of the off-balance-sheet motivation using agency theory in that over half the sample firms (self-) report they are subject to covenants. Nevertheless, it may be that firms believe they can improve the "looks" of their profit and balance sheet positions by using an *LP* to avoid the effects of in-house funding such that the variables selected do not capture this (naive) belief.

Second, the variables used to empirically test this motivation (leverage, interest coverage, and dummy variables for the existence of a dividend covenant and a management bonus plan) are all proxies, which may act to reduce the explanatory power of these variables. In the first set of regression tests, only the management bonus plan variable is significant. However, this result appears due to the measurement of the variables in the latest period prior to the formation of the *LP*. Firms may be motivated to choose the *LP* route to avoid covenant violations which would (might) arise if the R&D project were to be funded in-house. When the leverage and interest coverage variables are estimated as if the *LP*-funded R&D were actually funded in-house using all debt, the regression coefficients on these variables are found to be significant. However, the all-debt assumption underlying the construction of the as-if leverage variable may bias the tests toward this finding. The results for the as-if simulated tax rate and interest coverage ratios do not appear subject to this possible bias.

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[25] However, an argument may be made that these firm size differences are also consistent with a tax motivation based on the analysis by Majd and Myers [1985]. Their analysis, applied to the problem here, predicts smaller firms motivated bythe tax rules' asymmetric treatment of gains and losses will fund their major (large) R&D activities through *LP*s.

Third, it could be argued that taxes are a "first-order" effect which might dominate the "second-order" contracting cost effects of the off-balance-sheet motivation such that variables representing the latter may have little explanatory ability. However, the as-if results for the leverage, interest coverage, and management compensation variables suggest that both taxes and contracting cost variables have incremental explanatory power in the R&D funding choice.

The analysis in this paper suggests a number of possible future research avenues, two of which are discussed here. First, as noted, the regression results are sensitive to the measurement of the marginal tax rate variable. The traditional measure of tax rates, estimated income tax payable divided by estimated taxable income, is an average rate and, therefore, measures the marginal tax rate with error. A major contribution of this paper is the application of two alternative approaches to measuring corporate marginal tax rates. The first method is a simulation approach, which estimates the change in the present value of the tax payable as a result of earning an incremental dollar of income in the current period. The second method is an instrumental variables approach in which firm-specific variables predicted to be highly correlated with the firm's tax status are regressed against the simulated marginal tax rate. The predicted values from this regression then represent the instrumental variable estimates. Both of these approaches require further research to assess their validity under different scenarios and to determine which firm-specific variables exhibit the properties required for instrumental variables.

Second, the 1986 Tax Reform Act classifies gains and losses from limited partnerships as passive and not available to be used to offset active income of the limited partners. This reduces the attractiveness of R&D *LPs* to wealthy investors wishing to shelter some of their income. Therefore, this change in the tax law may allow a further test of the factors influencing *LP* usage. It is predicted that if *LPs* are motivated largely by tax considerations, there will be a dramatic decline in their usage after 1986.

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Unexpected Earnings, Firm Size, and Trading Volume Around Quarterly Earnings Announcements

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ABSTRACT: This study hypothesizes and finds that both the magnitude and duration of the trading volume reaction to quarterly earnings announcements are increasing functions of unexpected earnings and decreasing functions of a factor affecting the availability of predisclosure information: firm size. In contrast to unexpected earnings, which are not known until earnings are actually announced, firm size can be assessed prior to the announcement. Evidence that market reactions to quarterly earnings announcements differ systematically with a variable such as firm size, whose value is known *before* the announcement, may be relevant to policymakers in evaluating the potential benefits of differential accounting disclosure requirements (especially those based on firm size). Additional analysis, however, also confirms the incremental value of the actual earnings disclosures: even after controlling for the already known firm size, unexpected earnings are still positively related to the magnitude and duration of the trading volume reaction.

THIS study identifies, at the aggregate market level, factors that appear to be systematically associated with investors' use of accounting disclosures to make trading decisions.[1] In particular, this study hypothesizes that unexpected earnings (UE, hereafter) and firm size are related to both the magnitude and duration of trading volume reaction around quarterly earnings announcements.

Research seeking to explain market reactions to earnings has traditionally focused on factors such as the absolute value of UE (or the mere presence of the disclosure) which are not revealed until the time of the disclosure [e.g., Beaver, 1968; Beaver, Clarke, and Wright, 1979; Morse, 1981]. In contrast, factors that affect the availability of predisclosure information (e.g., firm size) may be assessed *before* earnings are announced

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[1] The FASB's Research Report on "Usefulness to Investors and Creditors of Information Provided by Financial Reporting: A Review of Empirical Accounting Research" [Griffin, 1982] devotes an entire chapter to "Research on the *Use* of Information in Capital Mar-

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(and hence before UE are known). Identification of a systematic relationship between an *ex ante* observable variable, such as firm size, and the magnitude and duration of the trading volume associated with accounting disclosures may enable policymakers to *anticipate* how the market reaction will differ across various firms' accounting disclosures. The Financial Accounting Standards Board (FASB) and Securities and Exchange Commission (SEC) may find this ability particularly useful in view of the recent trend toward considering firm-size-based differential disclosure requirements, such as Statement of Financial Accounting Standards (SFAS) No. 33 [1979], "Financial Reporting and Change in Prices" and SFAS No. 87 [1985], "Employer's Accounting for Pensions" (see paragraph 208).

This study also addresses questions arising from previous trading volume research. Upon finding that trading volume reaction to quarterly earnings announcements persisted longer than the price reaction, Morse [1981] called for research to explain trading volume's relatively slow adjustment process. To address his question, this study identifies factors associated with the duration of volume reaction to quarterly earnings announcements. The study also provides evidence relevant to the Ro [1981]-Freeman [1981] debate concerning the existence of a trading volume "size effect" analogous to that documented in price research by Atiase [1985].

Such questions arise because relatively little is known about trading volume, especially in comparison to price research. Although both price and trading reflect the same underlying economic factors, each may capture somewhat different aspects of investors' reactions.[2] Trading volume reflects investors' behavior or activity by *summing* all market trades, whereas security prices reflect an aggregation or *averaging* of investors' beliefs. The summation process establishing trading volume preserves differences between investors' interpretations of accounting disclosures that are suppressed in the averaging process that determines prices. If, for example, investors interpret an announcement differently, trading volume may be high as those who interpret the information favorably buy from those who interpret it unfavorably. However, the equilibrium price reflects an averaging of investors' beliefs, so the price may not change significantly if investors' belief revisions are largely counterbalancing. As a result, trading volume may be relatively more sensitive to individual differences in interpreting earnings information. It should not be surprising, therefore, that previous empirical research has documented differences between price and trading volume reactions to earnings announcements. In contrast to Fried and Givoly's [1982] price research results, Bamber [1986] found that trading volume around annual earnings announcements was much more closely associated with UE using a random-walk earnings expectation model than using analysts' forecasts. Also, Morse [1981] reports that the trading volume reaction to earnings announcements persists longer than the price reaction.

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kets" (emphasis supplied). Policymakers seem willing to infer a disclosure's usefulness to one group of users—investors—based on evidence of a capital market reaction. However, a market reaction (which researchers often interpret as evidence of a disclosure's "information content") is a reasonably stringent surrogate for an intuitive concept of "usefulness." Although a disclosure may prompt a belief change (i.e., it is "useful" in the ordinary sense of the word), unless the belief changes sufficiently to outweigh transactions costs and induce trading, a trading volume-based market reaction measure would not classify the disclosure as "informative."

[2] The following distinction between price and volume reactions builds on Beaver's [1968, pp. 69–70] discussion.

This study finds that as the absolute value of unexpected quarterly earnings increases, both the magnitude and duration of the trading volume reaction to quarterly earnings announcements increase. Previous research suggests that the "availability of predisclosure information" is an increasing function of an *ex ante* (in the sense that its value is known before earnings are announced) firm-specific variable: firm size. This study's results support the hypothesis that firm size is inversely related to the magnitude and duration of the trading volume reaction to quarterly earnings announcements. Loosely speaking, this means that the larger the firm, and hence the more information likely to be available from alternative sources, the less important the formal accounting earnings announcement and the smaller and quicker the reaction to that announcement.

HYPOTHESES

The Magnitude Hypothesis

Both policymakers and researchers are interested in the effects of accounting disclosures on financial markets. This study examines the relation between one type of accounting disclosure, quarterly earnings announcements, and one aspect of the market reaction, trading volume. Specifically, the first hypothesis posits that the greater the magnitude of unexpected earnings, the greater the volume of trading around the announcement date. A conceptual link between the magnitude of UE and trading volume emanates from theory and evidence regarding belief dispersion, or heterogeneity. Both capital markets and human information processing research suggest that, on average, the more informative a disclosure, the greater the subsequent dispersion of beliefs.[3] In turn, finance research suggests that heterogeneity of investors' beliefs or opinions is, on average, positively associated with trading volume.[4] More "surprising" or informative announcements are likely to spawn a wide variety of interpretations (belief dispersion), which in turn should generate increased trading volume. Consequently, as a first step, this study hypothesizes a positive association between UE and associated trading volume:

> H_{1A}: The larger the absolute value of unexpected earnings, the higher the unexpected trading volume around quarterly earnings announcements.

Policymakers, however, appear to be interested in *anticipating* accounting disclosures' differential effects on the market[5] [e.g., Griffin, 1982; SEC, 1977, Chapter 6]. It may therefore be helpful to identify a relation between the market reaction and a variable whose value is known *prior* to the announcement. Firm size is one such variable. Atiase's [1980] theory states that firm size affects incentives for private information collection; in particular, he argues that investors have lesser incentives to collect predisclosure information about smaller firms. Atiase [1985] reports empirical evidence consistent with this argument. Furthermore, with regard to *publicly* available information, both Atiase [1987] and Grant [1980][6] report that the *Wall Street Journal* mentions large firms more often than small firms.

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[3] That is, investors may differ in their *interpretation* of the information. Both conflict resolution theory [e.g., Abelson, 1959; Jaccard, 1981] and the information overload concept [e.g., Einhorn, 1971; Payne, 1976; Casey, 1980] suggest that providing "more" information increases the variability and decreases the predictability of subjects' responses. This position is supported by empirical human information processing (HIP) research which has operationalized "more information" both in terms of informativeness [Cohen, 1983] and the number of pieces of data [Nystedt, 1974; Payne, 1976; Casey, 1980]. Although theories and evidence from the individual level are not necessarily valid at the aggregate market level, Ajinkya, Atiase, and Gift [1986] report an analogous result in a markets context: analysts' mean *EPS* forecast revision (which should reflect the "amount" of information arriving in the market) is highly correlated with the dispersion of their earnings forecasts.

[4] Hakansson, Kunkel, and Ohlson's [1982] necessary and sufficient conditions for trading to occur in a pure exchange economy, and Grossman and Stiglitz's [1980] explanation of trading volume in markets characterized by rational expectations, both depend on the condition of heterogeneous beliefs and/or information structures. Moreover, Varian [1986] shows that under reasonable assumptions, trading volume is an increasing function of opinion dispersion (resulting from differences in *interpretation* of information, as well as differences in prior beliefs). Furthermore, Ajinkya, Atiase, and Gift [1986] empirically document a positive association between dispersion (of analysts' earnings forecasts) and trading volume.

Given that relatively little information regarding small firms is forthcoming (from either public or private sources) prior to the earnings announcement, investors are likely to find small companies' announcements especially informative. As discussed above, previous research suggests that more informative announcements should lead to greater belief dispersion, which in turn should generate abnormally high trading. Consequently, this study hypothesizes that firm size (which is known *before* earnings are announced, and hence *before* UE are known) is inversely related to the magnitude of the trading volume reaction:

> H_{1B}: The smaller the firm, the higher the unexpected trading volume around quarterly earnings announcements.

The Duration Hypothesis

In addition to the magnitude of quarterly earnings announcements' market effects, this study also examines the duration of those effects. Morse [1981] found that around earnings announcements, abnormally high trading volume persisted for a longer time than did abnormal price movements. As a result, he called for research to identify factors that would explain trading volume's relatively slow adjustment. This study hypothesizes that the market reaction's duration is an increasing function of the magnitude of the earnings announcements' informativeness. Previous behavioral research indicates that subjects receiving "more" information (1) need more time to respond, and (2) their response times are more variable than the response times of those receiving less information.[7] This implies that the greater the unexpected earnings (i.e., the more informative the announcement), the longer the period of abnormally high trading:

> H_{2A}: The larger the absolute value of unexpected earnings, the longer the period of abnormally high trading associated with quarterly earnings announcements.

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[5] For example, the Report of the Advisory Committee on Corporate Disclosure (to the SEC) states that:

> (K)nowledge about the importance or non-importance to investors of a variety of information types could assist the Advisory Committee in its determinations and recommendations concerning the areas of corporate disclosure which may need emphasis (or de-emphasis) [SEC, 1977, pp. 271–272].

[6] Although he does not examine firm size *per se*, Grant [1980] reports that fewer *WSJ* articles concern OTC firms than NYSE firms. Of course, the former are on average much smaller than the latter.

[7] Both levels-of-processing [Craik and Lockhart, 1972; Hastie and Kumar, 1979] and information overload concepts [Schroeder, Driver, and Streufert, 1967; Casey, 1980] suggest that providing "more" information increases subjects' response time. Empirical human information processing research supports this position by operationalizing the amount of information both in terms of the informativeness of the data [Brewer, Dull, and Lui, 1981; Hemsley and Marmurek, 1982; Lord, Foti, and DeVader, 1984; Sujan, 1985] and the number of pieces of data [Jacoby, Speller, and Berning, 1974; Casey, 1980]. Evidence in Casey [1980] also shows that the variation in subjects' response time increases as more information is provided.

From a policy perspective, it may be useful to *anticipate, ex ante*, those disclosures that are likely to be associated with a protracted market reaction. As discussed above, relatively little predisclosure information seems to be available regarding small firms, so investors are likely to find small companies' earnings announcements especially informative. An argument analogous to that made for hypothesis 2A can therefore be extended to firm size:

> H_{2B}: The smaller the firm, the longer the period of abnormally high trading associated with quarterly earnings announcements.

RESEARCH DESIGN

The Data

The data include approximately 900 first, second, and third quarter earnings announced by 195 firms between January 3, 1977 and March 30, 1981.[8] NYSE listed 172 of these firms, while the remaining 23 were listed on the AMEX or over-the-counter (OTC). The sample firms were randomly chosen from the approximately 1,600 firms listed in the *ValueLine Investment Survey* (*VL*).[9]

The sample firms' quarterly *EPS* forecasts were obtained from *ValueLine.* The forecast closest to one month before the firm's final quarterly earnings release was recorded. Although arbitrary, this criterion assured that the forecasts were reasonably current, but not based on preliminary *EPS* announcements. The final quarterly *EPS* and announcement dates were obtained from the *Wall Street Journal Index.*[10] Other major disclosures such as stock splits, mergers, divestitures, litigation, and strikes announced within one week of the earnings release date were deemed potentially confounding events, and the corresponding observations were discarded.[11]

Compuserve's *Value* data base provided (1) daily trading volume summed over all markets and adjusted for stock splits and dividends, and (2) total shares outstanding for each sample firm. Firm size measures were obtained from the COMPUSTAT file, or from *ValueLine* for non-COMPUSTAT firms.

The Variables

Trading Volume. Since there is no theoretical basis for choosing a particular measure of abnormal or unexpected volume, several different approaches were employed. The first measure followed prior research [e.g., Beaver, 1968; Nichols et al., 1979] by adjusting the percentage of shares traded for the overall market level of trading. The second metric, based on a firm-specific measure of normal volume, is the percentage of shares traded minus the firm-specific median daily percentage of shares traded.[12]

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[8] For reasons discussed in footnote 12, the sample includes only one earnings announcement per calendar date.

[9] From a personal interview with a *ValueLine* representative, I determined that firms listed in *VL* generally meet the following criteria:

1. capitalization in excess of $50,000,000,
2. at least 2,000,000 shares held by outside investors, and
3. over 100,000 shares traded per month.

If these criteria omit one or two major firms from a covered industry, *VL* includes the omitted firms. Likewise, if coverage is thin in a particular industry, *VL* makes an exception and includes smaller, less widely held or traded firms.

[10] Examination of the *WSJ Index* revealed that for only 13 of the 908 observations did management make preliminary earnings announcements (between the *VL* forecast date and the earnings announcement date) that were within 5¢ of the actual quarterly *EPS*. Since most of these preliminary announcements occurred in the week prior to the formal earnings disclosure, the analysis discussed in footnote 11 largely controls for any preliminary earnings announcement effect.

[11] The statistical analyses were repeated on observations which did not have earnings forecasts of any kind (either precise dollar amounts or relatively vague statements), nor dividend announcements within ± one week of the earnings announcement date. The resulting trading volume statistics and correlations were similar in magnitude, but had somewhat less significant alpha levels than those reported here, presumably due to the decreased sample size (about 70 percent of the original sample).

Calculation of the first trading volume metric follows Beaver [1968] by regressing each firm's percentage of shares traded on an index of market-wide trading. The Box and Cox technique [Montgomery and Peck, 1982] suggested that a log transformation of the dependent variable (percentage of firms *i*'s shares traded) would improve model specification. Additional analysis suggested a log transform of the independent variable (market-wide trading index) would further improve the regressions' explanatory power.

Three indices of market-wide trading were constructed—one based on NYSE firms, one on AMEX firms, and one on OTC firms[13]—despite Bamber's [1986] finding that the non-NYSE firms' trading was more closely associated with the NYSE trading index than with their own indices. That study suggested the more stable NYSE index might better capture the macroeconomic events affecting the market-wide level of trading, while the AMEX and OTC indices' large variances might reflect greater sensitivity to random fluctuations. Since a log transformation could affect this result by mitigating the effects of the non-NYSE indices' large variances, each firm's daily trading volume was regressed on its own exchange index (i.e., NYSE, AMEX, or OTC) as well as on the NYSE index. However, despite the log transformation, the AMEX and OTC firms' trading volumes are still more closely associated with the NYSE index than with their own exchange index. The median r^2 for non-NYSE firms' trading volume regressed on the NYSE index was 11.04 percent as opposed to only 1.27 percent for their own index (this difference was significant at $\alpha < .001$ by the Fisher sign test). Accordingly, subsequent statistical analysis is based on the following NYSE market index regressions:

$$ln(V_{it}) = a_i + b_i ln(V_{mt}) + \epsilon_{it}, \qquad (1)$$

where

V_{it} = percentage of firm *i*'s shares traded on day *t*,
V_{mt} = percentage of NYSE firms' shares traded on day *t*,
a_i, b_i = regression constant and coefficient (specific to firm *i*) determined by simple linear regression of daily data, and
ϵ_{it} = volume residual for firm *i* on day *t*.

The purpose of these regressions is to obtain parameter estimates (for use in conjunction with the index of market-wide trading) to calculate trading volume expected in the absence of an earnings announcement. Therefore, the parameter estimation period should not include those days immediately surrounding the earnings announcement date (EAD, hereafter). For each firm, regression parameters were estimated over the period January 3, 1977 to March 30, 1981 (inclusive), *except* the 15-day windows centered on the firm's earnings announcement dates. This estimation period is hereafter called the non-announcement period, although it is recognized that information other than quarterly earnings was announced during this period. The first measure of firm *i*'s unexpected trading volume on day *t*, VNY_{it}, is simply the regression prediction error:

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[12] Since this second trading volume metric makes no attempt to adjust for the effects (on trading volume) of economy-wide factors, the sample includes only one observation (i.e., earnings announcement) per calendar date. Although this minimizes cross-sectional correlation arising from economy-wide factors, it cannot eliminate the potential for cross-sectional correlation since other factors such as industry effects are not controlled.

[13] The three indices include all firms in Compuserve's *Value* data base meeting the following requirements:

1. the exchange listing of the stock is identified,
2. at least two years of trading volume data are available during the period 1977–1980,
3. the firm's stock was traded under normal conditions (the firm was not in bankruptcy, or subject to trading suspension, etc.), and
4. the stock was traded on at least one of two randomly selected dates during the test period.

The first two requirements ensure data availability, while the latter two attempt to match the market indices to the sample population. Since the sample population is biased in favor of widely held and actively traded firms, the latter two requirements remove infrequently traded stocks from the pool of index firms (more OTC firms than AMEX or NYSE firms were affected). The final OTC index included 2,209 firms; the AMEX index consisted of 738 firms, while the NYSE index had 1,475 firms.

$$VNY_{it} = ln(V_{it}) - [\hat{a}_i + \hat{b}_i ln(V_{mt})]. \quad (2)$$

The second trading volume metric is based on a firm-specific measure of normal volume. The first step was to calculate, for each calendar year, the median daily percentage of firm *i*'s shares traded in the non-announcement period. Abnormal volume is then defined as the difference between the actual percentage of shares traded on day *t* and the median non-announcement volume calculated over that calendar year:

$$VF_{it} = V_{it} - md[V_{it}]. \quad (3)$$

Subsequent statistical analyses of the magnitude hypotheses require point estimates of trading activity around the earnings announcement dates. Preliminary analysis suggested that the bulk of the trading reaction occurs on days −1 to +1 relative to the *WSJ* announcement date.[14] Consequently, point estimates of firm *i*'s trading volume are obtained by calculating, over a three-day test period centered on the EAD, firm *i*'s median (1) daily regression prediction error, VNY_{it}, and (2) daily firm-specific measure of abnormal trading volume, VF_{it}. These metrics are denoted $VNY3_i$ and $VF3_i$, respectively.[15]

Unexpected Earnings. Since the magnitude of unexpected quarterly earnings is unobservable and no single proxy perfectly captures the concept, this study employs several variations on two types of earnings expectation models: analyst forecast and random-walk models. Previous research [e.g., Crichfield, Dyckman, and Lakonishok, 1978; Brown and Rozeff, 1978, 1979; Collins and Hopwood, 1980; Fried and Givoly, 1982; Imhoff and Paré, 1982] suggested that financial analysts' *EPS* predictions are at least as accurate as those produced by statistical models. This result is intuitively appealing, since analysts have access to time-series models' predictions as well as other more recent information. Given the above, and the fact that *VL* forecasts are publicly available, *VL* forecasts should provide a reasonable proxy for sophisticated investors' *EPS* expectations. Hence, one measure of unexpected earnings, *UEA*, is defined as the absolute value of the difference between actual quarterly earnings per share and the quarterly earnings forecast, divided by the forecast *EPS*:

$$UEA = \left| \frac{EPS_{actual} - EPS_{forecast}}{EPS_{forecast}} \right| \quad (4)$$

Observations with forecast *EPS* between −5¢ and +5¢ were discarded due to the metric's sensitivity to *EPS*'s approaching zero.[16]

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[14] The large day −1 reaction appears reasonable, since earnings may be announced on the Broad Tape on the business day *before* they are published in the *Wall Street Journal* (see Patell and Wolfson [1982, p. 513]).

[15] The analysis was also repeated using (1) a standardized version of the first metric (VNY_{it} was divided by the standard deviation of firm *i*'s regression residual, calculated over that calendar year), and (2) the percentage of shares traded without any attempt to adjust for normal trading volume. These results are not reported since they are very similar to those from the other two measures. Furthermore, repeating the analyses using five-day and 11-day test periods (centered on the EAD) yielded results that are somewhat less significant, but otherwise quite similar to the three-day test period's results.

In contrast to previous price research [Fried and Givoly, 1982], Bamber [1986] found that trading volume around annual earnings announcements was more closely associated with unexpected earnings from a random-walk model than from analyst-based models. Consequently, this study also employs a less-sophisticated unexpected earnings metric based on a random-walk model. *UET* (the "time-series" metric) is defined as the absolute value of the difference between this quarter's *EPS* and *EPS* from the same quarter last year, divided by the latter:

$$UET = \left| \frac{EPS_t - EPS_{t-4}}{EPS_{t-4}} \right| \qquad (5)$$

This model assumes that investors simply expect this quarter's earnings to equal *EPS* of the same quarter last year.

UEA and *UET* both scale the dollar value of the unexpected *EPS* ($|EPS_{actual} - EPS_{expected}|$) via division by expected *EPS*, yielding a UE measure in terms of a percentage of expected *EPS*. Previous studies that scaled the dollar value of unexpected *EPS* generally used a similar approach. Nevertheless, it is not clear that expected *EPS* is the most appropriate denominator. Arguments can also be made for scaling by price, price-earnings ratio, standard deviation of *EPS*, and standard deviation of the earnings forecast error.[17] Replicating the analysis using each of these denominators did not affect the overall tenor of the study's results, so only the results based on the "expected *EPS*" denominator metrics (i.e., *UEA*, *UET*) are presented here.

Firm Size. Consistent with prior research [e.g., Atiase, 1985; Bamber, 1986], reported results are based on market value of common shares outstanding.[18] Measures based on total assets and total owners' equity yielded similar results and so are not reported here.

On average, the sample firms' market value increased over time. When pooled across firms and over time, an absolute size measure may be biased. For example, a 1977 observation may be a large firm in relation to 1977 observations, but small in relation to 1980 observations. Consequently, a relative size measure was calculated as the difference between a firm's year *y* market value and the median market value of the sample firms, calculated for the same calendar year.

SAMPLE FIRMS' CHARACTERISTICS

Table 1 presents summary descriptive

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[16] Beaver, Clarke, and Wright [1979] used a similar cutoff rule. In my study, the cutoff eliminated only 14 observations.

[17] Christie [1984] argues that the market value of equity (at the beginning of the period) is the "correct deflator" for use in *returns* studies. Although he does not extend this argument to studies based on *trading volume*, it nevertheless may be worthwhile to ascertain whether use of this deflator affects the study's results.

Moreover, the question arises as to what a \$1 unexpected *EPS* means to different firms. If firm A has a price per share of \$80 and firm B's price is \$20, one could argue that the \$1 unexpected *EPS* is in some sense more important to the second firm. Hence, price may be an appropriate denominator. Furthermore, if each of the firms' actual *EPS* is \$4, then A has a P/E ratio of \$80/\$4 = 20, while B's ratio is \$20/\$4 = 5. The \$1 unexpected *EPS* may be capitalized into a \$1 × 20 = \$20 effect on A's share price, but only a \$1 × 5 = \$5 effect on B's price. One could therefore argue that the unexpected *EPS* should be multiplied by the P/E ratio.

Alternatively, the meaning of \$1 unexpected *EPS* could also depend on the variability of the earnings stream. That is, a \$1 unexpected change in *EPS* might be in some sense more informative for a firm with a small variance in *EPS* than for a firm with a larger variance. This reasoning suggests that the variance of actual *EPS* would be an appropriate denominator. Finally, one could argue that the unexpected earnings should be related to the variability of past earnings prediction errors, rather than the variability of the *EPS* stream itself. This suggests scaling by the variance of unexpected earnings. (Thanks are due to Gary Sundem for suggesting this analysis.)

[18] Market value was calculated using the closing price on 12/31 of the *previous* year, per the COMPUSTAT files. Atiase [1980] theorizes that the incentive to search for *pre*disclosure information is a function of firm size. Hence, firm size is measured *before* the disclosure date.

TABLE 1

SUMMARY DESCRIPTIVE STATISTICS FOR SAMPLE FIRMS (1977-1981)

Median Daily Percentage of Shares Traded[a]	.0952%
Mean Daily Percentage of Shares Traded[a]	.1419%
Median Daily NYSE Index Trading Volume Residual[a,b]	−.0132
Median Market Value of Common Shares Outstanding[c]	129.567
Median Absolute Percent Error in *VL* Analyst Forecast (*UEA*)	16.66%[d]
Median Absolute Percent Error in Time-Series Forecast (*UET*)	26.57%
Median r^2 From Regression of Daily Trading Volume on NYSE Index of Market-Wide Trading	11.32%

[a] Calculated over all trading days from January 3, 1977 to March 30, 1981.
[b] From log-transformed data and regression on NYSE index.
[c] In millions of dollars.
[d] The *VL* analysts' forecast errors (*UEA*) are smaller, on average, than those based on the time-series forecast (*UET*), at $\alpha<.01$ by the Fisher sign test.

statistics for the sample firms. As expected, the mean percentage of shares traded exceeds the median. Further, despite the log transformation, trading volume residuals are still somewhat skewed, with medians below zero. Kolmogorov-Smirnov statistics (not shown) suggest that aside from the NYSE index metric (VNY_{it}), the other trading volume metrics were not normally distributed, nor were the unexpected earnings or firm size metrics ($\alpha<.01$). Therefore, results reported in the next section are based only on nonparametric statistical significance tests.

The finding that median absolute percentage error for *VL* forecasts is lower than that for the random-walk model implies that analysts have obtained "predisclosure" information—beyond the *EPS* for the same quarter of the previous year. This information may have been obtained from private search, or from public disclosures, including quarterly and annual reports released in the intervening period.

Table 2 shows the median *daily* trading volume *increase* (relative to the nonannouncement trading level) calculated over the three-day test period centered on the earnings announcement date, by quarter. The increase does not differ significantly across quarters, and each quarter's increase is significantly greater than zero ($\alpha<.0001$). Consistent with prior research [e.g., Kiger, 1972], quarterly earnings announcements are accompanied by abnormally high trading volume.

RESULTS

The Magnitude Hypothesis

H_{1A}: *The greater the absolute value of unexpected earnings, the greater the abnormal trading volume.* Panel A of Table 3 shows that median trading volume calculated over the three-day period centered on the quarterly earnings announcement date is an increasing function of the *ex post* observable unexpected earnings. Moving from the lowest *UEA* quartile, the trading volume metrics increase monotonically ($\alpha<$

TABLE 2

MEDIAN *Daily Increase* IN ANNOUNCEMENT PERIOD TRADING, RELATIVE TO NON-ANNOUNCEMENT TRADING

Trading Volume Metric[a]	*First Quarter* (N=305)	*Second Quarter* (N=306)	*Third Quarter* (N=297)	*Total* (N=908)
*VF*3 (firm-specific metric)[b]	.0227%	.0274%	.0227%	.0247%
*VNY*3 (NYSE index metric)[c]	.2760	.2331	.2906	.2539

[a] Increases in trading volume (relative to the non-announcement trading level) are significantly greater than zero at $\alpha < .0001$ by the Fisher sign test.

[b] *VF*3 is the median (calculated over the three days centered on the earnings announcement date) *daily increase* in percent of shares traded.

[c] *VNY*3 is the median (calculated over the three days centered on the earnings announcement date) *daily prediction error*, resulting from regressions of individual firms' trading volume on the NYSE-based index of market-wide trading. (The table reports the median *increase* in *VNY*, relative to the non-announcement level.)

.0001 by the Jonckheere test of ordered alternatives [Hollander and Wolfe, 1973]). Results based on the other UE and trading volume measures were similar and so are not reported here.

Panel B reports the results of Spearman rank correlation tests. For the sample as a whole, trading volume is positively correlated with the absolute value of unexpected earnings ($\alpha < .001$). On average, the larger the absolute value of UE, the greater the associated trading volume.[19] Although this overall result is consistent with previous evidence on annual earnings announcements, closer examination yields a difference. Based on Wolfe's procedure [Wolfe, 1977], Bamber [1986] found that trading volume around annual announcements was significantly more closely associated with unexpected earnings based on a random-walk model as opposed to an analysts' model. Panel B, however, provides no evidence of an analogous relation for quarterly earnings.

Moreover, panel B also shows that the degree of positive association between UE and trading volume differs across quarters. One possible explanation for the first quarter's weak results is that the sample firms' first quarter earnings are, on average, released only 49 days after the annual earnings announcement. Both second and third quarter earnings, on the other hand, are announced 63 days (on average) after the first and second quarter announcements, respectively. Hence, the information in the first quarter releases may be partially diluted by the relatively recent annual earnings announcements.

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[19] *ValueLine* divides the year into four 13-week quarters, and classifies the approximately 1,600 firms by industry. Each week, *VL* analyzes several industries, so they report on each industry (and firm) once within the 13-week quarter. Hence, revised analyses and earnings forecasts appear over varying 13-week intervals. This problem, combined with varying earnings announcement lags across firms, results in a range of lags between the *VL* earnings forecast and the earnings announcement dates. To ensure that the results were not affected by the recency of the *VL* forecast, I partitioned the sample into three groups based on the lag between the *VL* forecast date and the earnings announcement date. *UEA* and trading volume were positively correlated in each group (least recent forecasts, average recency, and most recent forecasts).

Since tax-motivated trading could also have affected the results, the analyses were replicated omitting the 73 December earnings announcements which are the observations most likely to be affected. Results were virtually identical to those reported here. It therefore seems unlikely that the results are driven by tax-motivated trading.

TABLE 3

TEST STATISTICS FOR H_{1A}—THE ABSOLUTE VALUE OF UNEXPECTED EARNINGS AND THE MAGNITUDE OF THE ASSOCIATED TRADING VOLUME

Panel A: Announcement Period Median Daily *Trading Volume Metrics—by Unexpected Earnings Quartiles*[a]

Trading Volume Metric	*UEA*[b]<6.7% (*N*=230)	6.7% ≤ *UEA* <16.7% (*N*=224)	16.7% ≤ *UEA* <42.9% (*N*=226)	42.9% ≤ *UEA* (*N*=228)	*Total* (*N*=908)
*VF*3 (firm-specific metric)[c]	.0088%	.0176%	.0272%	.0496%	.0247%
*VNY*3 (NYSE index metric)[d]	.1506	.1519	.2970	.4256	.2348

Panel B: Spearman Rank Correlations Between Trading Volume (Calculated Over the Three-Day Period Centered on the Earnings Announcement Date) and Absolute Value of Unexpected Earnings—by Quarter[e]

Measures of Absolute Unexpected Earnings and Trading Volume	*First Quarter* (*N*=305)	*Second Quarter* (*N*=306)	*Third Quarter* (*N*=297)	*Total Observations* (*N*=908)
I. UEA (*Analyst's Model*)				
Trading Volume Metric				
*VF*3	.0543 (.17)	.2740 (.001)	.1815 (.001)	.1709 (.001)
*VNY*3	.0499 (.19)	.2340 (.001)	.1843 (.001)	.1597 (.001)
II. UET (*Time-Series Model*)[f]				
Trading Volume Metric				
*VF*3	.0939 (.07)	.1001 (.06)	.2351 (.001)	.1370 (.001)
*VNY*3	.1058 (.05)	.1742 (.003)	.2456 (.001)	.1690 (.001)

[a] Differences across quartiles are significant at $\alpha < .0001$ by the Jonckheere test of ordered alternatives [Hollander and Wolfe, 1973].

[b] *UEA* is the absolute value of the difference between actual *EPS* and the *Valueline EPS* forecast, divided by the latter.

[c] *VF*3 is the median (calculated over the three days centered on the earnings announcement date) *daily increase* in percent of shares traded.

[d] *VNY*3 is the median (calculated over the three days centered on the earnings announcement date) *daily prediction error*, resulting from regressions of individual firms' trading volume on the NYSE-based index of market-wide trading.

[e] Parenthetical numbers give the approximate one-tailed significance level, given *N* observations.

[f] *UET* is the absolute value of the difference between actual *EPS* and *EPS* for the same quarter of the previous year, divided by the latter.

H_{1B}: *The smaller the firm, the greater the abnormal trading volume.* Panel A of Table 4 shows that median daily trading volume, calculated over the three-day period centered on the quarterly earnings announcement date, is inversely related to the *ex ante* observable firm size ($\alpha <$ .0001 by the Jonckheere test). That is, small firms' quarterly earnings announcements (which are less likely to be preempted by predisclosure information) on average generate a greater increase in trading than do larger firms' announcements (where more predisclosure information is presumably available).

Panel B reports the results of Spearman rank correlation tests. For the sample as a whole, trading volume is nega-

TABLE 4

TEST STATISTICS FOR H_{1B}—FIRM SIZE AND THE MAGNITUDE OF TRADING VOLUME ASSOCIATED WITH QUARTERLY EARNINGS ANNOUNCEMENTS

Panel A: Announcement Period Median Daily Trading Volume Metrics—by Firm Size Quartiles[a]

Trading Volume Metric	*Largest* MKT[b] *Quartile* (*N*=225)	*Medium-Large* MKT *Quartile* (*N*=233)	*Medium-Small* MKT *Quartile* (*N*=226)	*Smallest* MKT *Quartile* (*N*=224)
*VF*3[c]	.0111%	.0193%	.0302%	.0629%
*VNY*3[d]	.1240	.2484	.3257	.4006

Panel B: Spearman Rank Correlations Between Trading Volume (Calculated over the Three-Day Period Centered on the Earnings Announcement Date) and Firm Size—by Quarter[e]

Trading Volume Metric	*First Quarter* (*N*=305)	*Second Quarter* (*N*=306)	*Third Quarter* (*N*=297)	*Total Observations* (*N*=908)
*VF*3	−.0589 (.14)	−.2200 (.001)	−.1904 (.001)	−.1535 (.001)
*VNY*3	−.1048 (.02)	−.2148 (.001)	−.1793 (.001)	−.1655 (.001)

[a] Differences across quartiles are significant at $\alpha < .0001$ by the Jonckheere test of ordered alternatives [Hollander and Wolfe, 1973].

[b] *MKT* is the difference between a firm's year *y* market value and the median market value of all the sample firms in year *y*.

[c] *VF*3 is the median (calculated over the three days centered on the earnings announcement date) *daily increase* in percent of shares traded.

[d] *VNY*3 is the median (calculated over the three days centered on the earnings announcement date) *daily prediction error*, resulting from regressions of individual firms' trading volume on the NYSE-based index of market-wide trading.

[e] Parenthetical numbers give the approximate one-tailed significance levels, given *N* observations.

tively correlated with firm size ($\alpha < .001$). On average, the smaller the firm, the greater the trading volume associated with quarterly earnings announcements. Again, the relation is weakest for the first quarter. In summary, the results presented in Table 4 support the hypothesis that the magnitude of trading volume associated with quarterly earnings announcements is inversely related to firm size.

The Duration Hypothesis

Figures 1 and 2 plot the median daily NYSE index trading volume metric, VNY_t, from days −7 to +7 (relative to the *Wall Street Journal Index* announcement day), for the lowest versus highest quartiles of *UEA* and firm size, respectively. Tables 5, 6, and 7 present *z*-scores resulting from a Fisher sign test to determine whether the number of firm-observations exceeding their median non-announcement trading level is abnormally high for days −7 to +7. Results from the other trading metrics are similar and so are not shown here.

Table 5 presents Fisher sign test[20]

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[20] Recall that the Fisher sign test does not depend on the *magnitude* of the day *t* trading volume (as shown in the figures), *per se*. Rather, it is a *dichotomous* test that simply counts the proportion of observations where firm *i*'s day *t* trading exceeds its median non-announcement period of trading.

TABLE 5

FISHER SIGN TEST Z-SCORE STATISTICS FOR DETERMINING WHETHER DAILY TRADING VOLUME[a] EXCEEDS THE MEDIAN NON-ANNOUNCEMENT LEVEL OF TRADING—BY QUARTER

Day Relative to WSJ *Announcement*	*First Quarter* (N=305)	*Second Quarter* (N=306)	*Third Quarter* (N=297)	*Total Observations* (N=908)
−7	−.104	−.625	−1.219	−1.265
−6	.104	−.468	−1.372	−.964
−5	.468	−1.512	−1.533	−1.626
−4	.519	−1.246	.158	−.300
−3	1.504	−1.350	−.583	−.271
−2	−1.095	−.778	.370	−.782
−1	7.705[b]	6.688[b]	5.806[b]	11.785[b]
0	4.706[b]	5.029[b]	5.745[b]	9.052[b]
1	2.284	4.200[b]	3.110[b]	5.553[b]
2	2.907[b]	3.483[b]	1.107	4.296[b]
3	3.171[b]	1.508	.793	3.309[b]
4	2.243	2.181	1.001	3.275[b]
5	1.404	2.644[b]	.847	2.857[b]
6	1.716	2.181	.317	2.265
7	.414	1.879	1.110	1.925

[a] Results are based on *VNY*, the *daily regression prediction error* resulting from regressions of individual firms' trading volume on the NYSE-based index of market-wide trading.

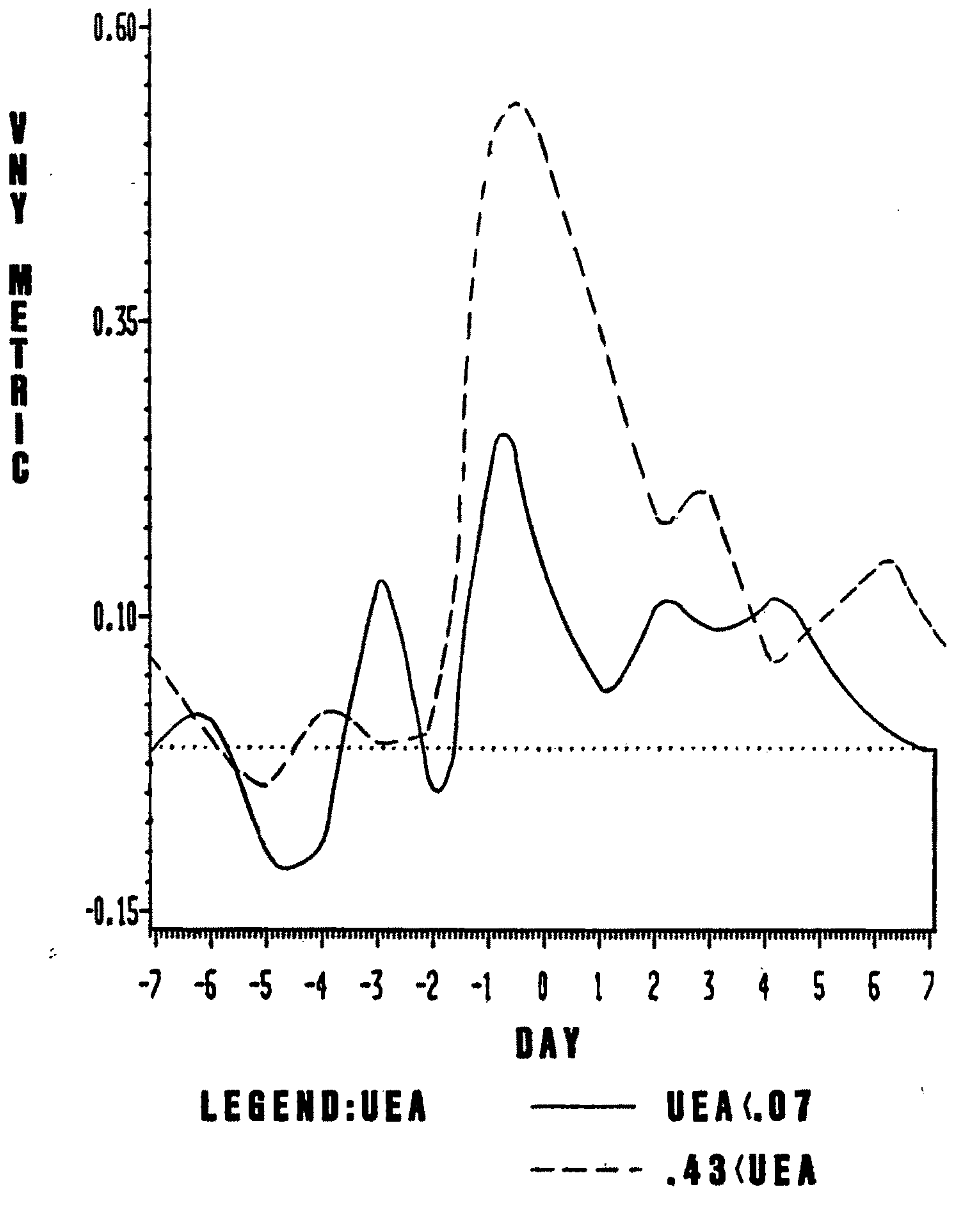
[b] The number of firm-observations whose day *t* (NYSE index) trading exceeds their median non-announcement trading is higher than expected at the .01 level.

z-scores for the sample as a whole, and by quarter. For the sample as a whole, trading is below average prior to the earnings announcement, but not significantly so. The bulk of the trading reaction occurs on days −1 and 0, with a gradual decline after day 0. However, abnormally high trading persists up to day +5, with some variation across quarters.

H_{2A}: *The higher the absolute value of unexpected earnings, the longer the period of abnormally high trading.* Figure 1 graphs the smallest versus largest *UEA* (analysts' model) quartiles' NYSE index trading volume metrics for a 15-day period, centered on the EAD. The figure confirms the magnitude hypothesis that larger *UEA* generate higher abnormal trading volume. The figure also supports the duration hypothesis since the high *UEA* quartile's *VNY*s exceed the low *UEA* quartile's *VNY*s from day −2 to day +7 (except for day +4). Table 6 shows that the number of firm-observations with higher than average trading is significant only on days −1 and 0 for the lowest *UEA* quartile, but is significant until day +2 for the highest *UEA* quartile. The data suggest a threshold effect, where the reaction lasts only two days for the two lower *UEA* quartiles, but lasts about four days for the two higher *UEA* quartiles.

H_{2B}: *The smaller the firm, the longer the period of abnormally high trading.* Figure 2 graphs the smallest versus largest firm size quartiles' NYSE index trading volume metrics. The figure supports

FIGURE 1
LOWEST AND HIGHEST *UEA* QUARTILES
NYSE INDEX TRADING VOLUME METRIC, VNY



both the magnitude and duration hypotheses: smaller firms' announcements (which are less likely to be pre-empted by predisclosure information) generate a greater increase in trading which persists for a longer time, relative to larger firms' announcements. Table 7 presents Fisher sign test z-scores for each market-value-based quartile. The results again suggest a threshold effect. Although the trading reaction is considerably shorter for the quartile of largest firms (about two

TABLE 6

FISHER SIGN TEST Z-SCORES FOR H_{2A}—DETERMINING WHETHER DAILY TRADING VOLUME[a] EXCEEDS THE MEDIAN NON-ANNOUNCEMENT LEVEL OF TRADING—BY UNEXPECTED EARNINGS QUARTILE

Day Relative to WSJ *Announcement*	*UEA*[b] <6.7% (*N*=230)	6.7% ≤ *UEA* <16.7% (*N*=224)	16.7% ≤ *UEA* <42.9% (*N*=226)	42.9% ≤ *UEA* (*N*=228)
−7	−1.195	−.132	.000	.066
−6	.066	−.658	−.263	.066
−5	−1.912	−.198	.396	−.921
−4	−1.974	1.253	−.132	.458
−3	1.053	−.396	−1.454	.065
−2	−.728	.000	−1.184	−.458
−1	3.758[c]	3.480[c]	6.368[c]	6.603[c]
0	2.440[c]	2.362[c]	3.742[c]	6.654[c]
1	.263	1.648	2.235	4.717[c]
2	1.656	−.853	3.158[c]	2.752[c]
3	.661	.725	.989	1.834
4	.925	2.229	1.974	.526
5	.925	1.579	1.447	1.572
6	−.066	.658	1.517	2.027
7	−.989	1.454	.661	1.957

[a] Results are based on *VNY*, the *daily prediction error* resulting from regressions of individual firms' trading volume on the NYSE-based index of market-wide trading.

[b] *UEA* is the absolute value of the difference between actual *EPS* and the *Valueline EPS* forecast, divided by the latter.

[c] The number of firm-observations whose day *t* trading exceeds their median non-announcement level of trading is higher than expected at the .01 level.

days), it is fairly equal across the three quartiles of smaller firms (about four days).

Additional Analysis

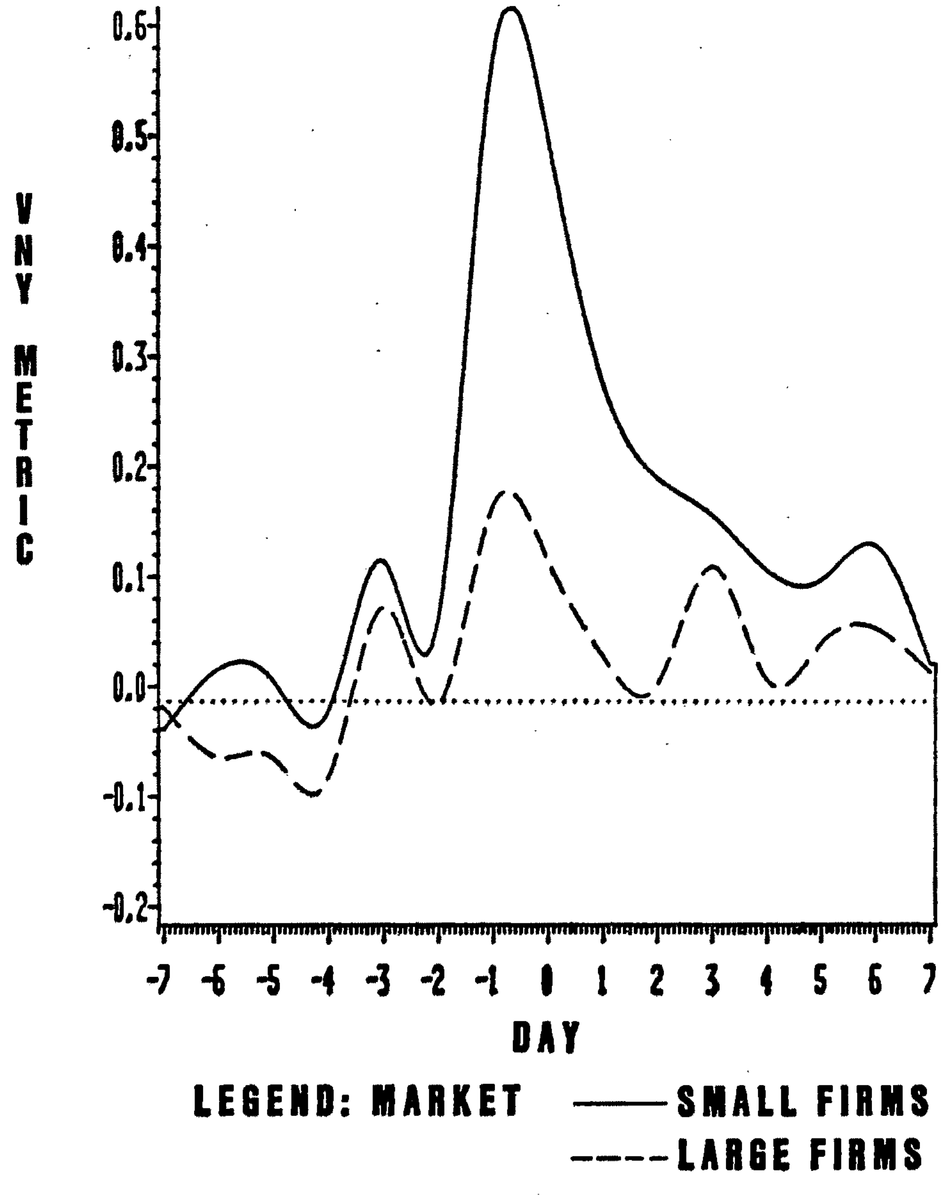
The results reported in Tables 3 to 7 suggest that firm size and UE are both related to trading volume reaction, as hypothesized. However, since only firm size is observable *ex ante*, policymakers may also be interested in whether UE (and hence earnings disclosures themselves) have any incremental explanatory power, beyond that of the already known firm size.

The results of a partial correlation analysis reported in Table 8 suggest that even when firm size is held constant, the magnitude of trading volume reaction is still positively associated with UE.[21] Consistent with the earlier use of Spearman rank correlation tests, which are simply the classical sample correlation coefficients applied to the ranks of

---

[21] Although regression analysis might at first glance seem to be the preferred method to isolate the effect of each independent variable (firm size and UE), it would be extremely difficult to avoid violating the underlying assumptions. In addition to satisfying the distributional assumptions, the negative association between firm size and UE (see Bamber [1986]) suggests that multicollinearity might adversely affect the power of the statistical inferences based on the regression coefficients. (Preliminary analysis supported this suspicion.) Since it is the analysis of the coefficients that would be of interest here, regression was deemed inappropriate. Furthermore, in keeping with the previous analysis, nonparametric statistical procedures were employed to minimize necessary distributional assumptions.

FIGURE 2
LOWEST AND HIGHEST MARKET QUARTILES
NYSE INDEX TRADING VOLUME METRIC, VNY



the variables [Hollander and Wolfe, 1973, p. 192], the partial correlations were also run on the *ranks*. These partial correlations were calculated between UE and trading volume, while controlling for firm size. The results are similar to those based on the simple correlation analysis reported in Table 3. On average, the larger the absolute value of UE, the greater the associated trading volume

TABLE 7

FISHER SIGN TEST Z-SCORES FOR H_{2B}—DETERMINING WHETHER DAILY TRADING VOLUME[a] EXCEEDS THE MEDIAN NON-ANNOUNCEMENT LEVEL OF TRADING—BY FIRM SIZE QUARTILE

Day Relative to WSJ *Announcement*	*Smallest* MKT[b] *Quartile* (*N*=225)	*Medium-Small* MKT *Quartile* (*N*=233)	*Medium-Large* MKT *Quartile* (*N*=226)	*Largest* MKT *Quartile* (*N*=224)
−7	−.701	−1.159	.636	.063
−6	−.128	−.386	−.318	−.190
−5	−.446	−1.221	.000	−1.202
−4	−.636	.385	.253	−.884
−3	1.084	−.192	−.191	.443
−2	.446	−1.288	.191	−.505
−1	7.400[c]	4.801[c]	4.943[c]	4.617[c]
0	6.388[c]	4.217[c]	4.183[c]	2.720[c]
1	3.549[c]	2.683[c]	3.181[c]	.884
2	2.677[c]	2.578[c]	3.042[c]	.316
3	.696	1.811	.636	2.214
4	.891	3.393[c]	1.018	.000
5	.826	.704	1.789	.569
6	.956	1.406	1.782	.949
7	.574	1.728	.701	−.063

[a] Results are based on *VNY*, the *daily prediction error* resulting from regressions of individual firms' trading volume on the NYSE-based index of market-wide trading.

[b] *MKT* is the difference between a firm's year *y* market value and the median market value of all sample firms in year *y*.

[c] The number of firm-observations whose day *t* trading exceeds their median non-announcement level of trading is higher than expected at the .01 level.

reaction, even when firm size is controlled. Consistent with the study's other findings, these significant overall results are driven by the second and third quarter observations. The first quarter results are at best only marginally significant. Note also that in Table 8 the partial correlation coefficients are in each case smaller than their counterpart simple correlation coefficients in Table 3. This is consistent with part (but not all) of the "UE effect" being explained by the "size effect."

To find out whether the *persistence* of the trading reaction to quarterly earnings announcements is still positively related to UE when firm size is controlled, the observations were ranked and then grouped into portfolios of 13 observations, according to firm size. (The first portfolio included the 13 smallest observations, etc.) Within each size-based portfolio, the observations were ranked by *UEA*. The five smallest *UEA* observations within each portfolio were classified as "small *UEA*" while the five largest were denoted "large *UEA*." Each portfolio's middle three observations were excluded from the analysis. The number of observations per portfolio was set at 13 to balance the need to control for (i.e., minimize the variation in) firm size while maximizing the variation in UE. (So that each portfolio would contain exactly 13 observations, the 11 largest observations were excluded from the analysis.)

The results reported in Table 9 suggest

TABLE 8

RANK-BASED *Partial* CORRELATIONS BETWEEN TRADING VOLUME (CALCULATED OVER THE THREE-DAY PERIOD CENTERED ON THE EARNINGS ANNOUNCEMENT DATE) AND THE ABSOLUTE VALUE OF UNEXPECTED EARNINGS, HOLDING FIRM SIZE CONSTANT—BY QUARTER[a]

Measures of Absolute Unexpected Earnings and Trading Volume	*First Quarter* (N=305)	*Second Quarter* (N=306)	*Third Quarter* (N=297)	*Total Observations* (N=908)
I. UEA (*Analyst's Model*)[b]				
Trading Volume Metric				
VF3[c]	.0385 (.26)	.2080 (.001)	.1389 (.009)	.1259 (.001)
VNY3[d]	.0218 (.36)	.1760 (.001)	.1323 (.012)	.1125 (.001)
II. UET (*Time-Series Model*)[e]				
Trading Volume Metric				
VF3	.0744 (.13)	.0267 (.34)	.2057 (.001)	.1010 (.004)
VNY3	.0683 (.16)	.1151 (.04)	.2139 (.001)	.1342 (.001)

[a] Parenthetical numbers give the approximate one-tailed significance level, given *N* observations.

[b] *UEA* is the absolute value of the difference between actual *EPS* and the *ValueLine EPS* forecast, divided by the latter.

[c] *VF3* is the median (calculated over the three days centered on the earnings announcement date) *daily increase* in percent of shares traded.

[d] *VNY3* is the median (calculated over the three days centered on the earnings announcement date) *daily regression prediction error*, resulting from regression of individual firms' trading volume on the NYSE-based index of market-wide trading.

[e] *UET* is the absolute value of the difference between actual *EPS* and *EPS* for the same quarter of the previous year, divided by the latter.

that even when firm size is controlled, higher UE are still associated with longer trading volume reactions. The table presents Fisher sign test z-scores to determine whether the number of observations exceeding their median non-announcement level of trading volume is abnormally high. Results are presented for the "small *UEA*" and "large *UEA*" groups. First, note that the size-based portfolios have successfully controlled for firm size: the difference between the "small *UEA*" and "large *UEA*" groups' market values is not significant at typical alpha levels. Moreover, the small difference is not in the expected direction—the large *UEA* observations are from slightly larger firms than are the small *UEA* observations. The results are very similar to those from the previous analysis where firm size was not controlled. Similar to the pattern evident in Table 6, Table 9 shows that for small *UEA*, the reaction lasted only about two days, while it lasted about four days for large *UEA*. Hence, even when firm size is controlled, the duration of trading volume reaction is positively associated with the absolute value of UE.[22]

In sum, the evidence presented in Tables 8 and 9 suggests that even controlling for *ex ante* observable firm size, the magnitude and duration of trading volume reaction are still positively asso-

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[22] Additional analysis on these portfolios which controls for firm size also supports the magnitude effect. On average, the trading volume associated with the large *UEA* observations significantly exceeded that associated with the small *UEA* observations (based on Fisher sign tests—not shown).

TABLE 9

FISHER SIGN TEST Z-SCORES TO DETERMINE WHETHER DAILY TRADING VOLUME[a] EXCEEDS THE MEDIAN NON-ANNOUNCEMENT LEVEL OF TRADING—BY UNEXPECTED EARNINGS GROUP, HOLDING FIRM SIZE CONSTANT[b]

Day Relative to WSJ *Announcement*	*Small* UEA (N=345)	*Large* UEA (N=345)
−7	−.166	.615
−6	−.055	.112
−5	1.822	−.112
−4	−.276	−.167
−3	−.165	.502
−2	−.333	−.502
−1	5.104^c	6.900^c
0	2.799^c	6.454^c
1	.989	4.563^c
2	2.205	3.399^c
3	.165	2.068
4	.716	.558
5	1.376	2.121
6	.110	3.014^c
7	−1.213	1.451
Median *UEA*[d]	5.333%	48.570%
Median *MKT*[e]	11.399	12.120

[a] Results are based on *VNY*, the ***daily regression prediction error*** resulting from regression of individual firms' trading volume on the NYSE-based index of market-wide trading.

[b] The observations were grouped into portfolios of 13 observations based on *MKT* (i.e., the difference between a firm's year y market value and the median market value of all sample firms in year y). The smallest 13 are in the first portfolio, and the largest 13 are in the 69th portfolio. Within each portfolio, observations were ranked by *UEA* (the absolute value of the difference between actual *EPS* and the *ValueLine EPS* forecast, divided by the latter). Within each portfolio, the five smallest *UEA* observations are classified "small *UEA*," while the five largest are denoted "large *UEA*." The middle three observations are excluded from this analysis.

[c] The number of firm-observations whose day t trading exceeds their median non-announcement level of trading is higher than expected at the .01 level.

[d] The difference between "small *UEA*" and "large *UEA*" groups' *UEA* is statistically significant at $\alpha < .001$ by the Wilcoxon signed rank test.

[e] The difference between "small *UEA*" and "large *UEA*" groups' *MKT* is not statistically significant at any meaningful level ($\alpha > .80$).

ciated with the *ex post* variable, the absolute value of UE.[23] UE consists of more than a "size effect"; it has some incremental power to explain trading volume reaction.

SUMMARY, CONCLUSIONS, AND IMPLICATIONS

Based on the sample period (1977–1981) and population (*ValueLine* firms), this study finds that the greater the unexpected quarterly earnings, the greater the magnitude and duration of the abnormal trading volume reaction. To facilitate prediction of which particular firms' announcements are likely to generate an extensive or sustained market reaction, however, it may also be useful to identify a relation between the market reaction and a variable whose value is known prior to the announcement. Firm size is one such variable whose value is known before earnings are announced (and hence before UE are known). Based on theory [Atiase, 1980] and evidence [Atiase, 1985] that investors' incentives to collect predisclosure information increase with firm size, it was hypothesized that investors would find small firms' announcements especially informative, thereby leading to an intense and sustained trading volume reaction (relative to that associated with larger firms' announcements). Results support these hypotheses. Specifically, relative to large firms' announcements (where predisclosure information is more likely to be available), trading volume reaction to small firms' announcements is larger in magnitude and lasts for a longer period of time, on average. The study's results also suggest that *ex post* observable unexpected earnings still have some incremental explanatory power, after controlling for firm size. This implies that regardless of firm size, higher unexpected earnings (i.e., more "surprising" announcements) tend to generate more intense and sustained trading volume reactions than do lower unexpected earnings.

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[23] It seems somewhat inconsistent to ask the inverse—given an *ex post* observable variable (UE), does an *ex ante* observable variable (firm size) have any incremental explanatory power? However, in the interest of reciprocity, analogous tests were run between firm size and trading volume, while controlling for UE. The results (not shown) varied across different measures of UE, firm size, and trading volume. Those results that were statistically significant generally supported the existence of a "size effect," in the hypothesized direction. Hence, there was weak evidence that even when UE are controlled, the magnitude and duration of the trading volume reaction is still inversely related to firm size. Further investigation of this issue is left to future research.

These results bear on several issues raised in previous research. First, Morse [1981] called for research to explain the relatively slow trading volume adjustment to earnings announcements. As summarized above, this study suggests that the duration of volume adjustment to quarterly earnings disclosures is an increasing function of unexpected earnings magnitude (even when firm size is controlled), and a decreasing function of firm size. Second, the Ro [1981]-Freeman [1981] debate centers on whether the size effect found in security price research [e.g., Atiase, 1985; Richardson, 1984] also exists for trading volume. Results presented here document an analogous systematic inverse relation between firm size and trading volume around quarterly earnings announcements. Therefore, when firm size is confounded with an independent variable of interest, future research should control for the documented size effect. Third, despite the log transformation, the NYSE trading volume index was still more successful than the AMEX and OTC indices in explaining AMEX and OTC firms' variation in trading volume. Unless future research develops more appropriate non-NYSE based indices, it appears that a NYSE-based trading volume index is not only easier to construct, but also is superior in explaining trading volume.

Finally, the results may have certain policy implications. Policymakers who want to promote quick and unbiased assimilation of information should be interested in evidence that trading volume reactions to small firms' earnings announcements persist for a longer period of time than the reaction to larger firms' announcements. Moreover, the magnitude of volume reaction to small firms' earnings exceeds that for large firms. This evidence is consistent with investors finding small firms' quarterly earnings more informative than those of large firms. Such evidence may be of special interest given the FASB's recent intention to explicitly consider firm-size-related differential costs and benefits of future required disclosures [Wishon, 1985] (see Atiase, Bamber, and Freeman

[1987] for further discussion).

This study's findings also raise questions for future research. First, although the duration results are consistent with theories and evidence from information processing literature (see footnote 7), it is also possible that institutional investors may focus on large firms, and that they may act more quickly than "average." Analysis of transaction size data could investigate the validity of this alternative explanation for the rapid reaction to large firms' announcements. Second, this study's hypothesized relations were weak and in some cases unsubstantiated for first quarter announcements. Future research could identify characteristics of first quarter announcements that make their market reactions less predictable than those of second and third quarter earnings disclosures.

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NOTES

Voluntary Financial Disclosure by Mexican Corporations

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ABSTRACT: This paper reports on voluntary financial disclosure practices of Mexican corporations and relates the extent of disclosure to firm size, financial leverage, and proportion of assets in place. Studying the voluntary disclosure of Mexican firms yields additional insights into factors behind voluntary disclosure choices, and enhances our understanding of the accounting institutions and practices of non-Anglo-American nations. Voluntary disclosure varies widely within a sample of 52 Mexican Stock Exchange-listed firms, and the extent of disclosure is significantly and positively related to firm size but not to financial leverage and assets in place.

THIS paper reports on the extent of voluntary financial disclosure by a set of Mexican corporations and tests the effects of three firm characteristics on disclosure. There are two objectives of this study. The first is to advance our understanding of accounting institutions and practices in non-Anglo-American nations. The second objective is to provide additional evidence on the factors behind voluntary financial disclosure. Many recent studies have hypothesized that firms' voluntary accounting and disclosure choices are aimed at controlling the interest conflicts among shareholders, debtholders, and management (see Holthausen and Leftwich [1983], Kelly [1983], and Watts and Zimmerman [1986] for reviews). It is held that the extent of these interest conflicts—hence the incentives behind voluntary accounting/disclosure choices—varies with certain firm characteristics. Since Mexico has a relatively unregulated accounting environment, it provides a suitable setting for testing the effects of these variables.

This Note is organized as follows. The first section provides an overview of the Mexican accounting environment. The next section describes the data collection procedures and reports descriptive statistics for the sample of Mexican firms. Results of cross-sectional regressions are then presented, followed by concluding remarks.

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ACCOUNTING REGULATIONS AND PRACTICE IN MEXICO[1]

Operations of business firms in Mexico are regulated by a number of federal agencies. The Ministry of Finance and Public Credit is by far the most important. This ministry includes the National Securities Commission (NSC), which administers Mexico's Securities Market Law and regulates the securities market.

The current version of the Mexican Securities Market Law was enacted in 1975. This Law regulates public offering and trading of securities, the Mexican Stock Exchange (a private corporation), and the activities of securities brokers and traders. Listing on the Mexican Stock Exchange requires approval by the NSC. Firms seeking such approval are required to submit a prescribed set of financial and non-financial information. Annual financial statements of listed firms must be certified by a Mexican certified public accountant, filed with the NSC, and published in a nationally-circulated medium.[2]

The NSC is the primary source of Mexican disclosure regulations. To date, the Commission's pronouncements in this area are contained in three "circulars" (similar to the U.S. Securities and Exchange Commission's Accounting Series Releases). While these regulations cover a large number of topics, their scope is still quite limited compared to what most larger U.S. firms are required to disclose. Further, they are mostly silent on issues of accounting procedures. There are also no federal or state laws that specify accounting practices. The primary source of accounting standards is the quasi-public Mexican Institute of Certified Public Accountants (IMCP). To date, the Institute's Accounting Principles Commission has issued 20 statements on generally accepted accounting principles. While these statements cover a broad range of accounting issues, they still appear to be far less comprehensive than their U.S. counterparts.[3]

The preceding summary of Mexican accounting and disclosure regulations suggests a much more *laissez-faire* environment than that in the U.S. An extensive search of the published accounting and business literature did not reveal any systematic study on how accounting/disclosure practices have responded to this environment in the period since the 1975 Securities Market Law.[4] Unstructured interviews with seven Mexican CPA firms' managing partners suggested that law enforcement is generally lax, and fraudulent accounting practices are common. Thus, firms in Mexico seem to have much more flexibility in accounting and disclosure practices than those in the U.S. Consequently, their accounting and disclosure choices are also more likely to reflect voluntary responses to market forces.

EMPIRICAL TESTS

This section addresses three topics. First, sample selection is explained. Then descriptive statistics on the extent of voluntary disclosure are presented and discussed. Finally, results of cross-sectional regressions are reported.

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[1] More detailed discussions of the Mexican accounting environment are available in AICPA [1975], Ernst & Whinney [1983], and Price Waterhouse [1981].

[2] The specific reporting requirements are contained in the Securities Market Law (Diario Oficial de la Federación [1975]).

[3] Overviews of U.S. accounting practices and regulations are provided by Benston [1976] and Nobes and Parker [1981]. A detailed comparison of U.S. and Mexican accounting regulations is beyond the scope of this study. However, an examination of the sources cited in footnote 1 suggests that this general observation is valid.

[4] Our primary focus was the *Business Periodicals Index* from 1978 to 1985. We also searched selected Mexican business periodicals and accounting texts. Mexican accounting practices in an earlier period are discussed in Zeff [1972].

Sample Selection

The sample firms were chosen from the Mexican federal government's 1982 *Official Gazette.* This daily (except Saturdays and Sundays) publication is the primary outlet for exchange-listed firms' required annual reports to external users. For the year 1982, the *Gazette* contained annual reports of 73 listed firms. The 13 banks within this set were dropped because they are subject to additional reporting regulations. We also eliminated eight firms from the service industry. The final sample of 52 firms all belonged to the manufacturing sector.[5] As such, their operations, and thus the types of information available for voluntary disclosure, should be relatively homogeneous in nature.

Extent of Voluntary Disclosure

A firm's extent of voluntary financial disclosure was operationalized with two alternate disclosure scores. These scores were obtained using a three-step process:

1. *Identifying Voluntary Disclosure Items.* By referring to the pronouncements of the Mexican authorities, Mexican accounting texts, and prior studies [Choi, 1973; Buzby, 1975; Barrett, 1976; Firth, 1979; and McNally, Eng, and Hasseldine, 1982], we generated a preliminary list of financial items that Mexican firms may disclose. This list was reviewed by the credit department heads of eight Mexican banks. Their feedback was used to compile a final list of 89 items.

Next, the managing partners of four large Mexican CPA firms were asked to indicate which items from the list were required to be disclosed by exchange-listed firms. Fifty-three items were unanimously classified as being required, and the remaining 36 were identified as being optional. These classifications were validated by examining the NSC and IMCP pronouncements.[6] Of the 36 voluntary disclosure items, 12 did not apply equally to all sample firms because they required an antecedent event (e.g., disclosure of lawsuits or auditor changes would require that such events had occurred). Hence, only the remaining 24 items were used to construct the disclosure scores.

2. *Rating the Importance of Each Disclosure Item.* Cooperation was obtained from the credit department heads of 16 Mexican banks, who distributed 106 survey instruments to loan officers in their departments. These officers were asked to indicate, on a seven-point scale, the importance they placed on each of the 89 items in evaluating an average loan application. The end-points were: (1) "Of no importance at all," and (7) "Of utmost importance." Respondents were asked to take into account the cost of information production in rating the importance of each item (in the manner of Choi [1973]). To control for order effects, eight random sequences of presenting the items were used.

A total of 67 completed responses were received, yielding a 63 percent response rate. The respondents had a mean of 4.6 years' experience as a loan officer ($s=3.6$ years). The mean number of loans each respondent processed per year was 102 ($s=144$), and the mean loan size processed was 43,122,000 pesos ($s=76{,}130{,}000$ pesos).[7] Since the survey was anonymous and all responses were received in a two-week period, data were not available for an effective test for non-response bias. However, given the high response rate and the profile of the respondents, the responses should be reasonably indicative of the judgments of experienced Mexican loan officers.[8]

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[5] These manufacturing firms came from a variety of industries. However, since there were only a few firms from each industry, it was not feasible to test for industry effects.

[6] All of the items classified as required were traced to NSC and IMCP pronouncements. We also verified that the items classified as not required were not part of these pronouncements. However, since it was not feasible to check all industry-specific regulations, there is still the potential for some items to be misclassified.

Table 1 presents the means, medians, and standard deviations of the voluntary disclosure items' importance ratings. These are rather widely dispersed. The highest-rated item—breakdown of borrowings—has a mean (median) rating of 6.194 (7.0), while the lowest-rated item —amount of past pension fund liability—is rated at 3.194 (3.0). Consensus among the respondent ratings was tested using an approach common in accounting research (see Libby [1981] and Ashton [1982] for reviews). For all possible pairs ($N=2{,}211$) among the respondents, the Pearson correlation was computed between the two respondents' 89 ratings. The mean (median) of these correlations was 0.24 (0.27) ($s=0.24$). These values are comparable to prior studies of judgment consensus (e.g., Wright [1977], Schultz and Gustavson [1978]; also see Ashton [1982]). Both the t-test and the nonparametric Wilcoxon rank-sum test indicated that the mean (median) of these pairwise correlations was significantly greater than zero ($t=46.60$, $p<0.0001$; $Z=33.43$, $p<0.0001$). Thus, on the whole, there is evidence of weak to moderate consensus among the respondents' ratings.

3. *Computing Disclosure Scores.* The reports in the *Gazette* were used to generate two disclosure scores for each sample firm. One was a weighted score (WTDSCORE); this was the sum of all the items (out of 24) that the firm had voluntarily disclosed, with each item being weighted by its mean importance rating. The other was an unweighted score (UNWTSCORE), which was the number of items voluntarily disclosed. The unweighted score was introduced to compensate for two potential limitations of the importance ratings. First, since these ratings were obtained through a survey and without real economic consequences to the respondents, they may not fully reflect loan officers' actual use of each item. Second, bank loan officers are only a subset (though an important one) of financial report users in Mexico. Using an unweighted score permits an analysis independent of the perceptions of a particular user group.

To control for subjectivity in interpreting the annual reports, two independent raters were used to determine which items were disclosed. Both raters were Mexican CPAs, and their ratings were in substantial agreement. For both WTDSCORE and UNWTSCORE, the Pearson correlation between their ratings was 0.98 ($p<0.0001$). In the statistical analyses, almost identical results were obtained by using either rater's ratings or their equally-weighted composite. Thus, only the results based on the composite measure will be reported here.[9]

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[7] Using an exchange rate of 300 pesos to one U.S. dollar, the average loan size processed would be U.S. $143,740.

[8] Since we emphasize disclosure incentives due to external financing, another important user group would have been financial analysts. Unfortunately, efforts to obtain such a sample were unsuccessful. Zeff [1972] suggests that Mexican firms are generally reluctant to reveal much about their financial affairs to the public, and that banks are often used as sources of outside capital to avoid public disclosure of sensitive financial information. Hence, our respondents should still represent a key user group.

[9] The composite WTDSCORE and UNWTSCORE measures were obtained by adding the scores assigned by the two raters and dividing the sum by two. Since the two raters did not agree perfectly, fractional values for UNWTSCORE (number of items disclosed) were possible. These were rounded up to the next whole number.

Table 1
Voluntary Disclosure Items: Descriptive Statistics and Frequency of Disclosure

	Importance Rating			Number (%) of Firms Disclosing This Item
	Mean	Median	Std. Dev.	
1. Breakdown of borrowings (e.g., lending institution, date of maturity, security)	6.194	7	1.28	39 (75%)
2. Description of major products produced	5.821	6	1.35	15 (29%)
3. Forecast of next year's profits	5.701	6	1.56	6 (12%)
4. Cash projections for the next one to five years	5.636	6	1.60	0 (0%)
5. Description of major plants, warehouses, and properties, including location, function, and size	5.582	6	1.45	23 (44%)
6. Discussion of the company's operating results for the past year	5.567	6	1.50	5 (10%)
7. Overall financing cost	5.254	5	1.42	38 (73%)
8. Names of company directors	5.224	5	1.71	46 (88%)
9. Information relating to capital expenditures (e.g., expenditure in the past year, planned expenditures)	5.209	5	1.46	20 (38%)
10. Disclosure of the responsibilities, experience, and background of corporate executives, and other key personnel such as research scientists and production managers	5.200	5	1.75	0 (0%)
11. Statement of company objectives	5.119	5	1.63	18 (35%)
12. Capitalized interests during the period	4.925	5	1.39	18 (35%)
13. Description of marketing network for finished goods/services	4.894	5	1.56	1 (2%)
14. Method used to determine cost of inventories	4.848	5	1.72	40 (77%)
15. Current resale value of the firm's assets	4.791	5	1.45	26 (50%)
16. The principal business or professional affiliation of each outside director	4.463	5	1.55	0 (0%)
17. Index of sales prices	4.246	4	1.81	14 (27%)
18. Breakdown of earnings by major product lines, customer classes, and geographical location	4.194	4	1.81	0 (0%)
19. Information relating to research and development (e.g., progress with new product development, planned expenditures)	4.167	4	1.53	5 (10%)
20. Number and type of ordinary shareholders (e.g., institutions, individuals)	4.136	4	1.86	5 (10%)
21. Specification of the method used to compute depreciation	3.877	4	1.68	39 (75%)
22. Information on corporate social responsibility (e.g., attitude of company, expenditures)	3.851	4	1.62	3 (6%)
23. Historical summary of price range of ordinary shares in past few years	3.288	4	1.51	4 (8%)
24. Amount of past pension fund liability	3.194	3	1.62	40 (77%)

TABLE 2

DESCRIPTIVE STATISTICS FOR THE INDEPENDENT AND DEPENDENT VARIABLES
(N=52)

Variable	*Mean*	*Median*	*Std. Dev.*	*Range*
Firm Size (SIZE) (10^3 pesos)	10,608,851	4,492,290	14,087,692	293,764–54,796,299
Financial Leverage (LEVG)	.79	.88	.21	.04–1.00
Proportion of Assets in Place (ASSETPLC)	.510	.542	.220	.002–.873
Unweighted Disclosure Score (UNWTSCORE)	7.86	9.0	3.90	0.0–17.00
Weighted Disclosure Score (WTDSCORE)	38.25	40.28	18.96	0.0–79.37

The last column of Table 1 presents the number of sample firms disclosing each item. In Table 1, the number of firms disclosing each item ranges from zero to 46, with a mean of 16.87. Five items are disclosed by at least 75 percent of the firms: (1) the names of company directors (N=46), (2) inventory costing method (N=40), (3) amount of past pension fund liability (N=40), (4) depreciation method (N=39), and (5) breakdown of borrowings (N=39). At the other extreme, no firm disclosed these four items: (1) cash projections for the next one to five years; (2) responsibilities and experiences of key executives and personnel; (3) principal business or professional affiliations of outside directors; and (4) breakdown of earnings by major product lines, customer classes, and geographical location. The number of firms disclosing an item is not significantly related to the item's rated importance. The Pearson and Spearman correlations between these variables were 0.086 (p=0.34) and 0.122 (p=0.28).

In addition to variation in the items' rated importance and disclosure frequencies, considerable divergence also exists among the sample firms' extent of voluntary disclosure. Table 2 shows that UNWTSCORE has a range of zero to 17, with a mean (median) of 7.86 (9.0). The range for WTDSCORE is zero to 79.37, and the mean (median) is 38.25 (40.28). The correlation between UNWTSCORE and WTDSCORE is positive and significant ($r=0.99$, $p<0.0001$).

Agency theory suggests several variables for explaining cross-sectional variation in voluntary accounting and disclosure choices. Firm size, financial leverage, and proportion of assets in place have been hypothesized to affect voluntary financial disclosure by influencing the magnitude of agency costs and/or the costs of manager-external owner contracting [Leftwich, Watts, and Zimmerman, 1981; Holthausen and Leftwich, 1983; Kelly, 1983]. Regressions using these three variables are reported below.

Cross-Sectional Regressions

The independent variables used are firm size, financial leverage, and proportion of assets in place:

1. *Firm size* (SIZE) is measured as the market value of equity plus the book value of debt. Jensen and Meckling

TABLE 3
RESULTS OF CROSS-SECTIONAL REGRESSIONS
(N=52)

		Coefficient (*t*-statistics in parentheses)					
Dependent Variable *Predicted Sign*	*Intercept* *N/A*	*SIZE* (*10^7 PESOS*) +	*LEVG* +	*ASSETPLC* −	*Adj.* R^2	F- (*sig.*)	*Kolomogorov-Smirnov* Z (*sig.*) *for the residuals*
WTDSCORE	26.26 (2.70)	5.16* (2.76)	13.35 (1.01)	−7.90 (−0.64)	.14	3.77 (0.02)	.73 (.66)
UNWTSCORE	5.41 (2.72)	1.11* (2.92)	2.54 (0.94)	−1.46 (−0.58)	.15	4.05 (0.01)	.82 (.52)

* $P<0.01$

[1976] have shown analytically that agency costs increase with the amount of outside capital, while Leftwich, Watts, and Zimmerman [1981] have suggested that the proportion of outside capital tends to be higher for larger firms. Accordingly, the potential benefits from shareholder-debtholder-manager contracting—including the extent of financial disclosure—would also increase with firm size.

2. *Financial Leverage* (LEVG) is measured by the book value of debt divided by SIZE. Fama and Miller [1972], Jensen and Meckling [1976], and Smith and Warner [1979], among others, have observed that agency costs are higher for firms with proportionally more debt in their capital structures, suggesting a positive relationship between the extent of voluntary financial disclosure and LEVG.

3. *Proportion of assets in place* (ASSETPLC) is computed by dividing the book value of fixed assets, net of depreciation, by total assets. Myers [1977] has suggested that wealth transfers are more difficult (hence agency costs are lower) with assets that are already owned than assets as yet to be acquired, implying that the extent of voluntary financial disclosure would be inversely related to a firm's proportion of assets in place.

The descriptive statistics in Table 2 indicate considerable cross-sectional variation in the three independent variables. Of the bivariate correlations among these variables, only that between SIZE and LEVG is statistically significant (r=0.34, p=0.013). The magnitude of this correlation does not suggest a serious collinearity problem. Both WTDSCORE and UNWTSCORE are significantly correlated with SIZE (respectively, r=0.41, p=0.002; and r=0.43, p=0.001), and both correlations with LEVG are marginally significant (respectively, r=0.24, p=0.08, and r=0.24, p=0.08). Neither disclosure score's correlation with ASSETPLC approaches statistical significance.

Table 3 reports the regression results using WTDSCORE and UNWTSCORE alternately as the dependent variable.[10]

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[10] Regressions were also run by replacing the market value of equity with its book value. The conclusions were unchanged. To allow for a nonlinear effect due to SIZE, the regressions were also repeated using this variable's natural logarithm instead of raw value. Again the conclusions were unaffected.

Both models are statistically significant, and the Kolmogorov-Smirnov test indicates that neither set of residuals deviates significantly from normality. However, of the three independent variables, only SIZE has statistically significant coefficients. The positive signs of these coefficients are consistent with the prediction of more extensive voluntary disclosure by larger firms. The predicted effects of leverage and assets in place are not supported.

CONCLUDING REMARKS

An overview of Mexican accounting and disclosure regulations suggests a more *laissez-faire* environment than that in the U.S. Using a sample of 52 Mexican Stock Exchange-listed firms, it is found that the extent of voluntary disclosure varies widely within this environment. Three variables suggested by agency theory—firm size, financial leverage, and proportion of assets in place—are used to explain this cross-sectional variation. The extent of voluntary disclosure is found to increase with firm size. No significant effects due to financial leverage or assets in place are observed.

This study has contributed evidence on disclosure practices in a non-Anglo-American country that has not been extensively examined. However, much effort is needed to refine and expand this investigation. First, the variables used should be refined and expanded. As Leftwich, Watts, and Zimmerman [1981] have observed, voluntary public disclosure is only one mechanism for containing shareholder-debtholder-manager interest conflicts. Alternative mechanisms include the use of outside directors, executive compensation schemes, restrictions on certain resource allocation activities (e.g., mergers, dividends, new financing, and disposal of assets), private disclosure, and indirect monitoring through exchange-listing requirements. To the extent these other mechanisms complement or substitute for corporate financial disclosure, their inclusion can shed further light on both the accounting environment and firm practices. Second, the effects of other factors (e.g., political costs) and motivations (e.g., signaling) on accounting/disclosure choices should also be explored [Watts and Zimmerman, 1986]. Finally, besides studying accounting/disclosure choices, the scope of analysis can be expanded to include the effects of such choices (e.g., wage negotiations and security prices).

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Client Control Environments: An Examination of Auditors' Perceptions

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ABSTRACT: The professional auditing literature identifies the need to evaluate a client's control environment prior to the auditor's design of compliance tests. This study seeks to: (1) identify client attributes that adequately describe a client's control environment; (2) investigate auditors' perceptions of the importance of these attributes on actual engagements; (3) highlight the contextual factors that condition the importance ratings of the attributes; and (4) ascertain the audit team member responsible for evaluating the various attributes. This study identified 48 client attributes that appear to serve as cues for auditors' control environment evaluations. The reported levels of importance for certain attributes differed across auditors. It was found that audit firm affiliation, auditor rank, audit office specialization, the client's management structure, and the client's total assets exhibited significant associations with auditors' ratings. In addition, it was found that seniors were responsible for evaluating most of the control environment attributes.

A CLIENT's control environment relates to the financial reporting system as a whole. It is a manifestation of management's attempt to identify, monitor, and control perceived inherent risks. At the same time, the control environment influences the design and implementation of internal accounting control systems that focus on separate, individual accounts or transaction cycles [Blocher and Willingham, 1985]. Because of these dual factors, external auditors must evaluate a client's control environment before determining their audit strategy [AICPA, 1979].

The fundamental purpose of this study is to provide a preliminary basis for understanding auditors' perceptions concerning a client's control environment. In this regard, four research objectives are: (1) to compile a list of client attributes that appear useful in understanding a client's control environment: (2) to examine auditors' ratings of the perceived importance of each of these attributes on actual audit engagements; (3) to investigate the relationship between contextual variables and the importance assigned to the attributes; and (4) to identify the audit team member believed to be respon-

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sible for evaluating each control environment attribute.

There are three primary motivations for pursuing these research objectives. First, as a number of parties have argued (e.g., Arthur Young & Co. [1980] and the AICPA [1985b]), the term "control environment" remains ill-defined and its components only broadly specified. Professional pronouncements (e.g., AICPA [1979 and 1985c]) enumerate general client control environment features such as the client's organizational structure, personnel, budgets, and financial reports, etc. However, if auditors plan to rely on the control environment to restrict audit tests, the specific control environment attributes on which such reliance is based need to be defined so that they may be evaluated and documented [AICPA, 1985a].

A second motivation for the study stems from the assertion that the determinants of an auditor's evidence evaluation may include not only features of the audit evidence itself, but also the context in which the evidence is obtained and the characteristics of the evaluator [Nanni, 1984]. In this vein, Libby and Lewis [1977, 1982] reported that contingencies between contextual variables and audit decisions are likely to be major determinants of relatively low levels of consensus reported in most research. They categorize contextual variables into three groups: (1) the auditor, (2) the audit firm, and (3) the client. Because there is no well-established theoretical literature suggesting how and which contextual factors should (or should not) influence a client control environment evaluation, this study examines the influence of contextual factors suggested by prior studies.

A third motivation for this study follows from the fact that neither prior research nor the AICPA has addressed the question of which audit team members are responsible for assessing the various client control environment attributes. The SEC [CCH, 1983] has asserted that the responsibilities of each audit team member should be clearly defined as part of competent audit planning. Since the control environment is a critical part of audit planning, this study investigates who auditors believed should have, and who actually did have, responsibility for evaluating each control environment attribute.

METHOD

Gibbins and Wolf [1982] justified the use of perceptual data in this type of study on the basis that "an understanding of judgment and decision processes must relate to the subjective representation of the situation by the . . . decision maker" [p. 106]. Similarly, Downey and Ireland [1979] noted that for research focusing on organizations' environmental attributes, subjectivity (perceptions) of those being studied may be the relevant focus for inquiry. For this reason, auditors' perceptions are the focus of the current study. This does not exclude the value of using "objective" measures such as archival data. However, because distinct control environment evaluations do not tend to be documented in practice, such a data source is not readily available. In addition, a controlled judgment-task research approach is viewed as more suitable for a subsequent study that seeks to test hypotheses derived from this initial inquiry's results.

Phase I

This study began with the identification of a probable set of relevant control environment cues. Three distinct stages of data collection were pursued. First, one- to two-hour, unstructured interviews were conducted with at least one practice office engagement partner from each of the Big Eight. These interviews aimed to identify partners' attitudes about the control environment attributes they believed to be applicable to a wide variety of clients. Any client features that they noted as creating or undermining a control environment were recorded. Second, pertinent in-house literature from each of the Big Eight firms was reviewed. Any significant client attributes discussed in these materials as potentially influencing a client's control environment were integrated with the listing derived from the previous interviews. In the final stage of Phase I, executive office research partners from five of the Big Eight reviewed each previously listed attribute for its relevance, clarity, and merit as a separately listed item. The final list of attributes is given in Table 1, along with the professional literature citations where each attribute is implied or explicitly mentioned as a feature of an organization's control environment. In addition, Table 1 also notes those few instances where prior empirical research has investigated these client attributes, albeit in different contexts than used in this study.

Phase II

A questionnaire was developed, pilot-tested, and administered. The questionnaire was designed in consultation with, and pilot-tested by, two partners and one manager from three different Big Eight firms and four auditing professors from three different universities. Each of the 48 control attributes headed a different page of the questionnaire, with each page asking the same series of questions. This permitted auditors to proceed through the document efficiently while also explicitly directing their attention to each attribute. The pages in the questionnaire booklets were randomized.

The administration of the final questionnaire identified a "referent client" for each respondent. These clients represented engagements that the auditors had recently completed or were currently auditing; they were designated as the context within which the auditors were to respond to the questionnaire. Referent clients were employed to help convey a rich, realistic, natural decision setting for the participants [Libby and Lewis, 1977]. The choice of referent clients and the related selection of participating auditors was done by a contact person (either a manager or partner) in each of the 31 participating Big Eight offices. The only restrictions placed upon engagement choices were: (1) the client(s) should be publicly traded and not a holding company; (2) the engagement was a recently completed or in-progress opinion audit; (3) the contact's audit office should have primary responsibility for the client; and (4) there should be no duplication of auditor-participants when multiple engagements were provided. Each contact person received an appropriate number of questionnaires on which they noted the referent client. They then distributed them, with their endorsement, to one junior, one senior, one manager, and one partner from each referent client's engagement team.

The questionnaire contained four sections pertaining to:

1. control environment attributes;
2. auditor profiles;
3. audit firm profiles; and
4. client profiles.

In the first section, for each of the 48 control attributes, auditors were asked two questions. The first question related to this study's first motivation: How much influence should the control attribute have on the assessment of the referent client's control environment?

TABLE 1

DESCENDING RANK ORDERING OF ATTRIBUTES COMPRISING A CLIENT'S CONTROL ENVIRONMENT

Attribute	*Importance Rating**		*Professional Literature Citation*	*Academic Literature Citation***
	Mean	*Std. Dev.*		
1. Existence of an appropriate policy for the authorization of transactions	1.68	.69	SAS 1	Joyce [1976]
2. Proper segregation of duties among client employees whose work is related to the financial reporting process (e.g., financial management, EDP, accounting, and internal audit personnel)	1.70	.76	SAS 1	Joyce [1976] Ashton [1974]
3. Effectiveness of general EDP controls	1.78	.81	SAS 3	
4. Effectiveness of physical safeguards over records and assets	2.03	.94	SAS 1	
5. Appropriateness of the internal audit staff's assigned duties, responsibilities, and lines of reporting	2.15	.98	SAS 9	Abdel-khalik et al. [1983]
6. Existence of factors that might motivate managers to circumvent or override existing controls (e.g., tight credit, low working capital, bonus plans, need to meet forecasts, decaying industry, etc.)	2.16	1.04	SAS 16	
7. Compulsion on the part of the client's top, executive management for reporting the most favorable financial picture	2.17	1.09	SAS 16	
8. Effectiveness of the internal audit staff in reporting detected deficiencies	2.20	1.02	SAS 9	Brown [1983]
9. Extent of knowledge on the part of the client's controller concerning FASB and SEC (where appropriate) guidelines	2.26	.98	SAS 5	Hylas & Ashton [1982]
10. Promptness with which errors in internal financial reports are detected and corrected	2.35	1.03	FERF	
11. Potential for errors in internal financial reports	2.50	1.08	SAS 47	
12. Reputation of the client's top, executive management for taking unusual business risks	2.53	1.07	SAS 16	Morris & Anderson [1976]
13. Effectiveness of internal financial reports in adequately highlighting, identifying, or isolating problems	2.55	1.01	SACIAC	
14. Extent of turnover in the client's top, executive management positions and the reasons for it	2.61	.99	SAS 16	M&A [1976]
15. Effectiveness of coordination among related functions for financial reporting purposes (e.g., sales, accounting, and production)	2.62	1.13	—	
16. Inferences that can be drawn concerning the relationship between prior audit adjustments and the competence of the relevant personnel	2.68	.94	SAS 20	H&A [1982]
17. Appropriateness of separate accounting systems for each of the client's diversified business endeavors (e.g., a client might have a mining division and a banking division)	2.68	1.29	SAS 30	

TABLE 1—*Continued*

Attribute	*Importance Rating** *Mean*	 *Std. Dev.*	*Professional Literature Citation*	*Academic Literature Citation***
18. Effectiveness of the client's policies and procedures manuals in regard to the financial reporting process	2.69	.87	SAS 22	Nanni [1984]
19. Manner in which recommendations of internal and external auditors have been dealt with in the past	2.77	1.01	SAS 20	M&A [1976]
20. Conscientiousness of the audit committee in the execution of their duties and responsibilities	2.77	1.19	SAS 16	
21. Adequacy of a client's analysis of budget variances	2.78	1.06	SAS 34	
22. Timeliness with which financial managers receive the information that they need	2.91	.92	—	
23. Extent to which the client's top, executive management is dominated by one or a few individuals	2.92	1.01	SAS 16	
24. Adequacy of the client's budgetary process in covering all units or functions	3.00	1.10	SACIAC	
25. Appropriateness of the client's actions in response to the Foreign Corrupt Practices Act of 1977	3.10	1.14	FERF	
26. Extent to which native personnel managing the client's foreign operations are allowed to exercise their discretion in financial reporting decisions	3.12	1.24	—	
27. Appropriateness of the client's chart of accounts	3.14	.98	FERF	
28. Accessibility of supervisors to employees, both of whose work is related to the financial reporting process (e.g., financial management, EDP, accounting, and internal audit personnel)	3.16	.95	—	
29. Appropriateness of client policies and practices of required vacations and rotation of duties for employees whose work is related to the financial reporting process (e.g., financial management, EDP, accounting, and internal audit personnel)	3.17	1.01	FERF	Ashton & Brown [1980]
30. Extent to which the client's line personnel (i.e., operations) review internal financial reports	3.20	1.12	—	
31. Congruency of responsibility with authority for the client's employees whose work is related to the financial reporting process (e.g., financial management, EDP, accounting, and internal audit personnel)	3.27	1.02	SACIAC	
32. Manageability of the workloads of client personnel whose work is related to the financial reporting process (e.g., financial management, EDP, accounting, and internal audit personnel)	3.29	.93	SAS 16	H&A [1982]
33. Adequacy of the process by which operating budgets are revised	3.35	1.12	SACIAC	
34. Incompatibility (if any) of centralized client management over decentralized operations	3.37	1.16	SAS 30	

TABLE 1—*Continued*

Attribute	*Importance Rating** *Mean*	*Std. Dev.*	*Professional Literature Citation*	*Academic Literature Citation***
35. Extent to which the client investigates the backgrounds and references of new employees whose work is related to the financial reporting process (e.g., financial management, EDP, accounting, and internal audit personnel)	3.38	1.02	FERF	A&B [1980]
36. Qualifications of the members of the Board of Directors	3.38	1.14	SACIAC	
37. Qualifications of the members of the audit committee	3.42	1.14	SACIAC	
38. Extent of client bonding of all employees who handle cash, securities, etc.	3.42	1.15	—	
39. Effectiveness of a client's communication of formal codes of conduct	3.46	1.06	FERF	Nanni [1984]
40. Appropriateness of client training programs for new or promoted employees whose work is related to the financial reporting process (e.g., financial management, EDP, accounting, and internal audit personnel)	3.58	.99	SACIAC	
41. Relevance of an internal financial report to the person receiving it	3.66	1.07	SACIAC	
42. Adequacy of client planning for staff needs in regard to employees whose work is related to the financial reporting process (e.g., financial management, EDP, accounting, and internal audit personnel)	3.67	.97	SAS 16	
43. Existence of client programs for ongoing evaluation of employees whose work is related to the financial reporting process (e.g., financial management, EDP, accounting, and internal audit personnel)	3.71	1.03	SACIAC	
44. Compatibility of the client's *formal* organizational structure with its organizational goals	3.80	1.02	SACIAC	
45. Extent of a client's monitoring of its competition	3.83	1.02	SAS 22	
46. Compatibility of the client's *informal* organizational structure with its organizational goals	3.90	.92	SACIAC	Katz [1979]
47. Appropriateness of the information bases used in determining raises and promotions for the client's employees (management and staff) whose work is related to the financial reporting process (e.g., financial management, EDP, accounting, and internal audit personnel)	4.15	.96	FERF	
48. Appropriateness of the information bases used in determining raises and promotions for the client's employees (management and staff) whose work is not directly related to the financial reporting process	4.26	.90	FERF	

Ratings: 1 = very great, 2 = great, 3 = moderate, 4 = low, 5 = none

TABLE 1—*Continued*

* To provide additional assurances that Phase I of the study generated a list of cues truly applicable to a wider spectrum of auditors' perceived notions of a client control environment evaluation, 99-percent confidence intervals were constructed around each control attribute's median importance rating as well as around each attribute's proportion of ratings other than those of "no importance." Only control attributes #47 and #48 had confidence intervals encompassing the "none" rating.

** These studies pertain to auditor tasks in one of the following ways: (1) program planning, (2) internal control systems evaluation, or (3) discovery of financial statement errors. These contexts are assumed to be most relevant to the study reported here. Only the research regarding attributes #30 and #35 found the attributes to be unimportant audit cues.

Auditors' responses to this question were elicited along a five-point, Likert-type scale ("none" to "a very great deal") and were used to assess the relevance of each attribute in contributing to a detailed, descriptive portrayal of the control environment. To address the study's third motivation, auditors were also asked who should have primary responsibility for assessing the particular control attribute for the referent client. For this question, respondents identified, by rank, the appropriate team member. To reduce ambiguity, a completed sample page was included in all questionnaire booklets.[1]

The second motivation of this study underlies the final three sections of the questionnaire which gathered data pertaining to pertinent contextual variables. Consistent with SAS No. 22 [AICPA, 1985c] on audit planning, prior studies have suggested the relevance of the following client characteristics:

Client
- size and trend of client profits [Wright, 1983];
- management focus (external/internal), industry, and predictability of financial performance [McAllister and Dirsmith, 1982];
- leverage, management structure, information system, and personnel turnover [Anderson et al., 1970]; and
- changes in client size [Morris and Anderson, 1976].

In addition, prior studies have also suggested these other contextual variables as mediating auditor judgments:

Auditor
- prior work experience [Mock and Turner, 1981];
- specialized industry training [Blocher, 1980];
- years of experience (rank) [Nanni, 1984];

Audit Firm
- tenure with client [Wright, 1983];
- different offices within a firm [Mock and Turner, 1981];
- different firms [Cushing and Loebbecke, 1986];
- audit team turnover [Anderson et al., 1970]; and
- industry specialization and change in office size (suggested by Phase I interviewees).

Each of these contextual variables was operationalized according to its discussion in the respective prior studies (see Appendix).

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[1] Perceptions regarding the "actual" importance assigned to each attribute were also gathered. The few differences between these responses and the normative responses are discussed in Haskins and Henarie [1985]. Perceptions regarding who "actually" had primary responsibility were also gathered. There were no noteworthy differences between these responses and the normative responsibility responses.

RESULTS AND DISCUSSION

Response Rates

The sample of participants is not random but does include audit teams from all the Big Eight, eight different cities, each of the various audit levels, and a variety of clients (the Appendix contains a summary client profile). Questionnaires were distributed to 228 auditors (57 four-person audit teams). This yielded a response from 146 auditors (64 percent response rate), from 40 different audit teams (28 complete teams, ten three-member teams, and two two-member teams). All questionnaires returned were complete and usable.[2]

Each auditor responded to three debriefing questions. The mean "interest in task" rating was 3.0 (1 = dull, 7 = very interesting) while the "clarity of instructions" rating was 4.3 (1 = unclear, 7 = very clear). The mean time to complete the task was 127 minutes. Debriefing responses were similar across audit ranks and their correlations were not significant.

Consensus

The control environment attributes generated from Phase I represent an inventory of cues presented to auditor-subjects. Table 1 portrays the 48 attributes in descending rank order based upon the means and standard deviations of the auditors' ratings of their importance. The standard deviations reported in Table 1 indicate that there is a diversity of perceptions regarding the importance of many of the attributes. This diversity must be considered in the context of this study's use of referent clients. Blocher and Willingham [1985] have suggested that there are common control environment concerns across a spectrum of clients. However, the AICPA [1986, p. 7] has suggested that the importance of some individual control environment attributes "is significantly influenced by the [client's] size, complexity, and ownership characteristics." Coupling these two assertions results in the expectation that for those control environment attributes with importance-ratings differences, those differences should not be associated with client-related contextual variables, except perhaps along the dimensions of client size and complexity (all referent clients were publicly owned). Such an expectation does not preclude the possibility, nor confound the interpretation, of low levels of auditor consensus regarding the attributes' perceived levels of importance. In fact, given that the control environment evaluation is a highly judgmental and inherently ill-structured task [AICPA, 1985a], differences in importance ratings are likely to occur and to be associated with different audit firms [Cushing and Loebbecke, 1986] and with different auditor ranks [Nanni, 1984], possibly resulting in low overall levels of consensus.[3] The results of this study are consistent with these general expectations.

Critical Attributes

The control environment attributes which were most consistently ranked as having "great" importance were:

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[2] The response rates were lowered by the fact that the New York City practice offices of four firms did not complete the questionnaires. This is attributed to the fact that executive office partners were used as contacts for these particular offices, rather than practice office people who tend to be able to respond to research requests of this sort with fewer inconveniences (i.e., they could give the research materials to the audit team on one of their current engagements).

[3] Typical measures of consensus (mean pairwise correlations [Joyce, 1976]) applied to this study's data do indicate low levels of consensus. The mean pairwise Spearman correlations for the importance ratings, adjusted via Fisher's Z transformation, were .377 and .387 when auditors' ratings were partitioned by rank and by firm, respectively. The mean correlation between all possible pairs of auditors was .365.

- #1 Appropriateness of client's policy concerning the authorization of transactions;
- #2 Segregation of duties of client personnel involved in the financial reporting process;
- #3 Effectiveness of client's general EDP controls;
- #4 Effectiveness of client's physical safeguards over records and assets;
- #5 Appropriateness of client's internal audit staff's duties and lines of reporting; and
- #9 Controller's knowledge of FASB and SEC accounting guidelines.

These client attributes are frequently noted as key internal accounting control considerations in the existing literature. Therefore, their appearance at the top of the list is not surprising. However, Graham [1985] has also noted that the attributes of a client's control environment are important cues for identifying and assessing a client's inherent risks. Thus, these particular attributes' consistently high importance ratings may help solidify opinion concerning some of the factors to be considered if a separate assessment of inherent risk is made.

Also receiving very high importance ratings, but with greater variability in those ratings, were:

- #6 Existence of factors that might motivate managers to circumvent or override existing controls;
- #7 Compulsion on the part of the client's top, executive management for reporting the most favorable financial picture;
- #8 Effectiveness of the internal audit staff in reporting detected deficiencies; and
- #10 Promptness with which errors in internal financial reports are detected and corrected.

These attributes indicate auditors' concerns for the possibility of management override of financial reporting controls and the client monitoring of that possibility. These high ratings are consistent with SAS No. 16 and No. 17 [AICPA, 1985c] and the findings of Joyce and Biddle [1981]. However, they are in contrast to Kaplan and Reckers [1984], who found client management integrity to be an insignificant factor in auditors' planning process.

Noncritical Attributes

Those control attributes most consistently perceived as having little importance were:

- #40 Appropriateness of training programs for new personnel involved in the financial reporting process;
- #42 Adequacy of client planning for staffing needs in the financial reporting area;
- #44 Compatibility of the client's formal organizational structure with organizational goals;
- #46 Compatibility of the client's informal organizational structure with organizational goals;
- #47 Appropriateness of the bases used in determining raises and promotions for people involved in the financial reporting process; and
- #48 Appropriateness of the bases used in determining raises and promotions for personnel *not* involved in the financial reporting process.

It is perhaps surprising to find attributes #47 and #48 rated so unimportantly. Agency theory (e.g., Wallace [1980]) would suggest that auditors should be concerned with the factors

TABLE 2

CONTROL ENVIRONMENT ATTRIBUTE FACTOR GROUPINGS* AND FACTOR CORRELATIONS

Factors

Internal Financial Reporting (A)	*Internal Audit (B)*	*Budgets (C)*	*Organization (D)*	*Board of Directors (E)*	*Top Management (F)*	*Personnel (G)*	*Internal Control Procedures (H)*	*Miscellaneous (I)*
#10 #22	#5	#21	#28	#20	#6 #14	#15 #35	#1 #4	#25
#11 #27	#8	#24	#31	#36	#7 #23	#17 #40	#2 #29	#26
#13 #30		#33	#44	#37	#9 #45	#32 #43	#3 #38	#47
#16 #39			#46		#12			#48
#18 #41								
#19 #42								

Factor Correlations

Factors	*A*	*B*	*C*	*D*	*E*	*F*	*G*	*H*
B	−.20							
C	−.19	.17						
D	.28	−.14	−.07					
E	−.16	.24	.25	−.16				
F	−.29	.18	.20	−.26	.25			
G	−.26	.19	.19	−.28	.21	.25		
H	.24	−.01	−.10	.16	−.04	−.12	−.20	
I	.23	−.25	−.21	.20	−.21	−.36	−.28	.05

* A maximum likelihood, oblique rotation was used with factors having eigenvalues ≥ 1.5 being selected for analysis. Within factors, only attributes with loadings ≥ .30 were considered significant. Attribute #34 was the only one not loading onto one of the factors.

that motivate client personnel.

Both control attributes #44 and #46 were assigned very low ratings of importance. Auditors were fairly consistent in their agreement that the informal (#46) and formal (#44) aspects of a client's organizational structure were a minor audit concern. This contradicts Katz [1979] and the SACIAC [AICPA, 1979], who have noted the significance of organizational structure in providing an overall framework for control.

The personnel-related control attributes also received low importance ratings. Auditors indicated very little concern for the training of client personnel involved in the financial reporting process (#40), their ongoing evaluation (#43), or the planning (#42) that anticipates future personnel needs. These particular low ratings may be indicative of an aspect of internal control that Hylas and Ashton [1982] note should receive closer audit attention.

Relationship Among Attributes

Joyce and Libby [1982] noted that in the real world, audit cues are often correlated. It is common to find a group of related evidential sources forming the basis on which a final evaluation of a key audit control element is made (e.g., employee competency and integrity are distinct attributes, but ones that must be assessed aggregately in rendering a final evaluation on the reliability of a key client employee). To identify such relationships among the control environment audit cues, an exploratory factor analysis was performed.[4] Table 2 presents the resulting factor groupings.

As can be deduced from Table 2, the pattern of control attribute factor loadings is intuitively appealing, resulting in eight interpretable groupings: internal financial reporting (excluding budgets), internal audit, budgets, organization, board of directors, top management, personnel, and internal control procedures. These factors are quite consistent with the more generalized control environment categories proposed by the AICPA [1979, 1986] and reflect the cues' interrelations.

Context Effects—Sources of Differing Perceptions

The association between a contextual variable and a control environment attribute's ratings was subjected to two tests. First, auditors' importance ratings were cross-tabulated with the contextual data to test for the existence of an association. Either a statistically significant ($p \leq .05$) k-sample Medians test or a chi-square test for independence provided indications as to whether an association existed [Noether, 1976].

The second test involved a screening for only the strong associations. Asymmetric lambda was used for assessing strength of association for nominal contextual variables, and Kendall's tau b or c was used for the ordinal contextual variables.[5] Table 3 presents the various contextual variable and control environment attribute associations that passed both the tests for "existence" and "strength."

Client Contextual Variables. Consistent with the AICPA's [1986] assertions, client size and complexity were the client variables most frequently associated with the control environment attributes' ratings. More specifically, it has been suggested elsewhere that an organization's size is positively correlated with (1) the extent to which formalized control mechanisms will be used [Tracy and Azumi, 1976] and (2) heightened auditor sensitivities to certain audit risk factors [Anderson et al., 1970]. Auditor responses reflect these links in that for larger clients,[6] increased importance was reported for such formal controls as physical safeguards (#4), EDP controls (#3), internal auditors (#5 and #8), and client training (#40), and for such inherent-risk indicators [Blocher and Willingham, 1985] as the client's promptness in detecting and correcting errors (#10), the client's handling of prior audit recommendations (#19), the incompatibility of centralized management over decentralized operations (#34), and the client's informal organizational structure (#46).

Following Loretta [1983], as a client's management structure becomes more decentralized, and thus more complex, communication mechanisms such as budgets (#24), codes of conduct (#39), client training (#40), internal auditors

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[4] Because of the desire to allow the attributes' intercorrelations to be preserved, the method of maximum likelihood factor analysis, with an oblique rotation, was deemed most appropriate [Joreskog, 1984].

[5] Asymmetric lambda does not generate a significance statistic but does provide a measure of proportional reduction in error. However, based upon Goodman and Kruskal [1963], confidence intervals can be constructed for lambda. Based upon several such calculations for the data in this study, it can be generally concluded that for lambdas ≥ 10, a 90 percent confidence interval centered around lambda does not include zero. Therefore, $\geq .10$ is used as an indicator of a strong nominal variable association when the test statistic lambda is used. On the other hand, the tau b and c statistics do generate a significance measure. Because there were no prior directional hypotheses stipulated, the Kendall tau b and c tests were two-tailed. According to Nie et al. [1975], tau b is appropriate when the number of rows equals the number of columns in a cross-tabulated table and tau c is appropriate when the table is rectangular. Strong associations as measured by tau b and c were assumed to exist when $p \leq .10$.

[6] Compatible with Wright's [1983] focus on clients with "large" and "medium" total asset profiles, this study grouped clients into two total asset categories (>\$100 million and ≤\$100 million).

(#8), and audit committees (#37) acquired greater importance. Likewise, the more decentralized the client's management structure, the more important the issue of compatibility between such things as formal organizational structure and organizational goals (#44), management structure and operations structure (#34), and separate accounting systems for different lines of business (#17) (see Mouzelis [1979]).

Audit Firm Contextual Variables. The firm affiliation of the auditors exhibited more associations with the attributes' importance ratings than any other contextual variable. This result may be due to the different degrees of structure employed by the firms in addressing the internal control phase of an audit [Cushing and Loebbecke, 1986]. Specific control environment attributes exhibiting significant associations with the audit-firm variable include the following highly rated attributes: segregation of duties (#2), internal audit's responsibilities (#5), and the effectiveness of the internal audit function (#8). Other factors contributing to a high degree of control consciousness whose differing importance ratings were associated with the audit-firm variable included: client employee training (#40) and evaluation (#43), management's inclination to report the most favorable financial position (#7), effective use of formal codes of conduct (#39), and the client's formal organizational structure (#44).

There is also a strong relation between the importance attributed to certain control environment attributes and whether the audit office specialized in that particular type of client.[7] In general, control attributes pertaining to top management turnover (#14), timeliness of financial managers' receipt of information (#22), qualifications of the Board of Directors (#36) and audit committee (#37), and extent of employee bonding (#38) were all viewed as more important for offices specializing in their referent client. Eichenseher and Danos [1981] have posited that economies of scale exist for an auditing firm when they specialize in an industry, translating into more efficient and effective audit focuses. The increased importance of these attributes across various industry specialists suggests that it may be appropriate for nonspecialist offices to modify their focuses accordingly in order to enhance audit efficiency and effectiveness.

Auditor Contextual Variables. Consistent with Ashton [1973], the results of this study indicate that as the auditors' rank increased, decreasing importance was assigned to control attributes pertaining to the compatibility of management structure vis-a-vis operations structure (#34), the relevance of internal financial reports to the person receiving them (#41), the compatibility of the formal (#44) and informal (#46) organizational structure with corporate goals, the extent of client monitoring of their competition (#45), and the appropriateness of the information bases used in determining raises and promotions for financial (#47) and nonfinancial (#48) employees. In addition, a highly rated attribute, effectiveness of general EDP controls (#3), also exhibited the same association. Regarding these lower-rated attributes, it can be interpreted that more experienced auditors may have a better understanding of critical control relations and thus, certain cues such as these acquire less importance as auditors gain more experience in identifying other key controls

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[7] Specialization was assumed to exist if 20 percent or more of the office's chargeable hours were for clients in the same industry as the referent client. This cutoff is in line with Rhode, Whitsell, and Kelsey [1974]. Sixteen of the 40 engagements represented in this study noted a client specialty. The 16 specializations were spread across 11 different industries.

TABLE 3

ASSOCIATIONS BETWEEN CONTROL ENVIRONMENT ATTRIBUTES AND CONTEXTUAL VARIABLES*

	Contextual Variables		Control Attributes with Ratings of "Great Importance"											Control Attributes with Ratings of "Low Importance"								
			1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*40*	*41*	*42*	*43*	*44*	*45*	*46*	*47*	*48*
CLIENT	Industry	1																				
	Mgmt. Focus	2					−[x]															
	Client Personnel Turnover	3					[x]															
	Total Assets	4			[x]	[x]	[x]			[x]		[x]		[x]						[x]		
	Change in Total Assets	5							−[x]													
	Leverage (TD/TA)	6									[x]											
	Change in Profit	7									[x]											
	Info. System	8													[x]					[x]		
	Mgmt. Structure	9								[x]				[x]				[x]				
AUDIT FIRM	Years Auditing Client	10				[x]																
	Office Specialize in Client	11																				
	Change in Office Size	12							[x]				[x]									
	Audit Team Turnover	13																				
	Firm	14		[x]			[x]		[x]	[x]				[x]			[x]	[x]				
	City	15																				
AUDITOR	Auditor Rank	16			−[x]										−[x]			−[x]	−[x]	−[x]	−[x]	−[x]
	Prior Work Experience	17									[x]			−[x]								
	Specialized Training	18																				
Total Associations			0	1	2	2	4	0	3	3	3	1	1	4	2	0	1	3	1	3	1	1

TABLE 3—*Continued*

	Control Attributes with Ratings of "Moderate Importance"																												
Contextual Variables	*12*	*13*	*14*	*15*	*16*	*17*	*18*	*19*	*20*	*21*	*22*	*23*	*24*	*25*	*26*	*27*	*28*	*29*	*30*	*31*	*32*	*33*	*34*	*35*	*36*	*37*	*38*	*39*	*Total Strong Associations*
1						[x]																[x]							2
2						−[x]										−[x]							−[x]						4
3			[x]					[x]	[x]																				4
4								[x]															[x]						9
5															−[x]		−[x]												3
6														[x]						[x]									3
7																							−[x]						2
8																							[x]						3
9						[x]		[x]					[x]										[x]			[x]		[x]	9
10																							[x]						2
11			[x]					[x]			[x]														[x]	[x]	[x]		6
12											[x]										[x]								4
13																													0
14						[x]		[x]															[x]					[x]	11
15																												[x]	1
16																							−[x]					[x]	9
17											[x]																		3
18																													0
Total Associations	0	0	2	0	0	4	0	5	1	0	3	0	1	1	1	1	1	0	0	1	1	1	8	0	1	2	1	4	75

* Several contextual variables were highly correlated. The predictability of performance variable was highly correlated ($p \leq .01$) with the total assets variable. Because of the judgmental nature of the auditor response called for on it (five-point Likert scale), because of the intuitive link between size and predictability, and because every time it exhibited an association with a control attribute the total assets variable did too, the predictability of performance variable was dropped. Only two other pairs of contextual variables (management focus/years auditing client, and leverage/prior work experience) were so highly correlated. However, unlike the predictability of performance demographic variable, (1) each of these pairings exhibited associations with a control attribute in tandem only once, (2) their tandem appearance was not the only association for either of the variables in the pairings, and (3) there was no intuitive reason for their correlation.

[Ashton, 1973]. The inverse relations between auditor rank and the importance of the client's general EDP controls may be attributed to the notion of responsibility [Nanni, 1984]. Evaluations of general EDP controls often involve prescribed questionnaires completed by the audit staff. Even though this attribute's overall importance rating was high, those most responsible for its documentation and evaluation can be expected to weight it most importantly.

Nonsignificant Contextual Variables. Finally, the contextual variables exhibiting no, or just a few (<4), associations with the control environment attributes were:

1. client industry;
2. client management focus;
3. client personnel turnover;
4. client information system;
5. client's leverage, change in total assets, and change in income;
6. audit team turnover;
7. years audit office affiliated with client;
8. city of audit office;
9. change in audit office size;
10. prior work experience of auditor; and
11. specialized training of auditor.

As noted earlier, the fact that seven (out of nine) referent client contextual variables were not frequently associated with the attribute ratings lends support to Blocher and Willingham's [1985] assertion concerning the generalizability of control environment factors across a variety of clients. Consistent with Wright [1983], the tenure of the audit office's affiliation with the client was insignificant in explaining ratings differences.

Responsibility for Attribute Evaluation

Complementing the analysis of pertinent control environment attributes and their contextual associations is an analysis of auditor responsibilities for evaluating those factors. Big Eight in-house literature generally stipulates that either the manager or senior should have primary responsibility for evaluating the control environment. As indicated in Table 4, the results of this study are quite consistent with that proposition. In addition, there was no significant relation between a control attribute's level of perceived importance and the rank of the auditor perceived to have audit responsibility for evaluating it.[8]

Table 4 also indicates the control environment attributes for which a statistically significant difference in opinion existed concerning who the auditors believed should be primarily responsible for evaluating the attribute. However, in none of the 13 instances where this occurred were the auditors with differing perceptions from the rank designated by the group as being responsible for evaluating an attribute.

In regard to specific control attributes, results indicate that partners were perceived to be primarily responsible for evaluating control environment attributes pertaining to the conscientiousness of the audit committee (#20) and the qualifications of both the Board of Directors (#36) and the audit committee (#37).

In total, the list of 48 control environment attributes contained eight attributes that referred to the client's financial management personnel (motivations for circumventing controls (#6), compulsion for reporting favorable financial picture (#7), competence (#9), reputation for taking risks (#12), turnover

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[8] The Spearman correlation coefficient between auditors' "Who should be responsible?" responses and their importance ratings for the 48 attributes was −.027.

TABLE 4

PERCEPTIONS OF WHO SHOULD HAVE RESPONSIBILITY FOR EVALUATING CONTROL ENVIRONMENT ATTRIBUTES

Control Environment Attribute	*Person Responsible* (Percent)*	*Different Perception***	*Control Environment Attribute*	*Person Responsible* (Percent)*	*Different Perception***
1	S (66)		25	M (54)	
2	S (72)		26	M (64)	
3	S (58)		27	S (76)	
4	S (68)		28	S (70)	
5	M (51)		29	S (69)	
6	M (61)	S(J)	30	S (59)	
7	M (53)	P(P)	31	S (62)	M(M,P)
8	S (57)		32	S (69)	
9	M (61)		33	S (68)	
10	S (69)		34	M (58)	
11	S (66)		35	S (49)	
12	M (47)	P(P)	36	P (58)	M(J,M)
13	S (58)	M(P)	37	P (57)	M(J)
14	M (46)	P(P)	38	S (66)	
15	S (74)		39	S (46)	M(P)
16	S (49)		40	S (60)	
17	S (57)		41	S (64)	
18	S (63)		42	S (51)	
19	S (46)		43	S (59)	
20	P (51)	M(J,M)	44	M (44)	S(J)
21	S (66)		45	M (51)	
22	S (65)		46	S (53)	
23	M (45)	P(P)	47	S (51)	M(P)
24	S (63)		48	S (54)	

J=Junior, S=Senior, M=Manager, P=Partner

* Represents the designee as indicated by the auditors' modal response. The parenthetical number indicates the percent of auditors electing the modal response.

** In those instances where a particular audit team rank designation differed from the overall group designation, such a difference is noted only if *both* the association statistic (chi-square) and the strength of association statistic (Kendall's tau *b*) were significant at $p \leq .10$ for a cross-tabulation of the responding auditors' rank with the audit rank of their response. If so, the different beliefs are noted as M(P), which means the partners' responses indicated that they believed the manager should be the audit team member with primary responsibility for evaluating the particular control environment attribute.

(#14), domination by one or a few individuals (#23), role of foreign nationals in managing overseas operations (#26), and structure (#34)). All eight of these attributes were perceived to be areas for audit manager evaluation.

LIMITATIONS

Felix and Kinney [1982] have noted several disadvantages of using questionnaires in auditing research. First, self-insight problems may exist, resulting in responses that are more indicative of attitudes and perceptions than final judgments or actual decision making. To minimize this possible disparity, the questionnaire elicited auditors' responses in the context of a referent, real-world client. Moreover, the timing of the questionnaires' distribution coincided, as closely as possible, with the internal control planning phase of that particular engagement. Although this approach does not capture actual decision weights, such a design placed the research task as close as possible to the actual real-world task concerns.

In the use of questionnaires, several limiting biases often exist. One such limitation here is a selection bias because only Big Eight auditors and publicly traded clients were used. Within such a limitation, however, a broad profile of participants and clients was used. Response biases were addressed by: (1) using key contact managers or partners to endorse and coordinate administration of the questionnaire; (2) executing pre-scheduled follow-ups to avoid late responses, and (3) randomizing the presentation of control attributes.

Another limitation of the study is that participants were asked not to collaborate in completing the questionnaire in order to provide a basis for investigating perception differences between audit ranks. In practice, control environment evaluations are likely to involve audit team consultations.

Last, it is likely that several of the contextual variables are correlated, potentially confounding some of the interpretations (see footnote to Table 3). Also, the measurements used for some of these variables were subjective and rough. Given the absence of theoretical guidance in measuring them, measurement approaches used in prior studies were employed here.

CONCLUDING REMARKS

This study identified 48 client control attributes and their perceived levels of importance in adequately describing a client's control environment, thus serving to define more clearly this audit planning concept and to facilitate its evaluation and documentation [AICPA, 1985a]. In addition, empirical evidence was provided regarding the contextual factors that mediated the control attributes' perceived levels of importance. Consistent with Blocher and Willingham [1985], client contextual variables were not frequently associated with the attributes' importance ratings (except size and management structure), thus highlighting their generalizability across a variety of clients. Audit firm, firm specialization, and auditor rank were found to be significant mediating contextual variables. Also, it was found that seniors had the largest share of the evaluation responsibility.

Authoritative bodies may find this study to be of value as they consider amending SAS No. 1 to explicitly address client control environment evaluations [AICPA, 1985a and 1986]. For example, identification of the contextual factors associated with specific control attributes' importance ratings, and the evidence of variability in those ratings, may provide a basis for discussing the extent and nature of authoritative guidance necessary to support reliance on a client's control environment [AICPA, 1985b].

Appendix

Client Contextual Variables

1. INDUSTRY (mark *one* according to client's predominant source of revenues)

Manufacturing (please specify)	70	Financial Services (please specify)	29
Utilities	8	Other Services	23
Wholesale/Retail	16		

2. MANAGEMENT

A. Which *one* of the following best describes the predominant focus of this client's strategy for enhancing profits?

39 tends to focus on internal matters (e.g., controlling costs and developing or refining their technological bases)

20 tends to focus on external matters (e.g., monitoring actions of competitors, suppliers, and customers in order to exploit opportunities)

87 tends to exhibit a balanced focus, both internally and externally

B. Over the last three years, in which category(ies) did the client experience significant personnel turnover? (The categories are intended to be mutually exclusive.)

49 top executive management only

52 accounting department only

40 EDP department only

33 others whose job was affiliated with the financial reporting process

34 none

3. CLIENT FINANCIAL DATA

A. Total assets are:

38 less than $100,000,000

108 greater than $100,000,000

B. The client's change in total assets from the year prior to the cover sheet audit date is:

5% or more decrease	26	15% or more increase	39
4% or less decrease	22	14% or less increase	56
		No change	3

C. The Total Debt/Total Assets ratio, as calculated from balance sheet amounts for the cover sheet audit date, is:

110 40% or less

36 40% or more

D. The client's change in net income from the year prior to the cover sheet audit date is:

30% or more decrease	18	30% or more increase	49
29% or less decrease	25	29%-20% increase	30
		19% or less increase	24
		No change	0

4. INFORMATION SYSTEM

Over the last three years, which *one* of the following best describes the client's financial reporting system?

20 changed from predominantly manual to predominantly EDP

0 changed from predominantly EDP to predominantly manual

102 no change—has remained predominantly EDP

24 no change—has remained predominantly manual

5. STRUCTURE

How would you characterize the client's management structure? Place an "X" in the appropriate space.

Highly Decentralized	4	23	18	43	58	Highly Centralized

AUDIT FIRM CONTEXTUAL VARIABLES

1. How many years has this practice office been the principal auditor for this client? ________

2. Would you say that your practice office "specializes" in clients in this industry? As a guide, if 20% or more of your office's chargeable audit hours are for clients in this industry, consider it a specialty. ________

3. Over the past three years this practice office's professional auditing staff has (in numbers) . . . (Place an "X" on the appropriate line)

________ grown slightly.

________ grown a great deal.

________ not changed substantially.

________ decreased slightly.

________ decreased a great deal.

4. For your practice office's audit team, and for the audit date of this client as noted on the cover sheet versus the prior year's audit, there was . . . (Place an "X" on the appropriate line)

YES NO

____ ____ a change in the lead engagement partner assigned.

____ ____ a change in the lead engagement manager assigned.

____ ____ a change in the lead engagement senior assigned.

5. Firm name ________________________________

6. City of this audit office ________________________________

AUDITOR CONTEXTUAL VARIABLES

1. Your position title: ________________________________

2. Have you ever worked in a professional capacity outside of public accounting? YES ________ NO ________

Type of position: ________________________________

Type of industry: ________________________________

3. Have you received any specialized industry audit training?

YES ________ NO ________

(please specify industry) ________________________________

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Effects of Outcome Information on Evaluations of Managerial Decisions

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ABSTRACT: This paper examines the effects of outcome information on managerial decision evaluations. Specifically, based on cognitive considerations, hypotheses are developed about a base-line effect of outcome information and attenuation of that effect by: (1) the evaluator's prior involvement with the evaluatee's decision process, and (2) the extent to which reported outcomes imply evaluatee responsibility for anticipating such outcomes. The hypotheses are confirmed by the results of an experiment set within the context of capital budgeting. Implications of these results are discussed in terms of information system design and the process of generalizing psychological research into accounting contexts.

An important task within organizations is evaluation of employee performance. Inevitably, at least some outcome information is available when such performance is evaluated; that is, performance evaluations are conducted in varying degrees of "hindsight." Despite evidence in the probability judgment literature that hindsight judgments can be "biased" [Fischhoff, 1982a and b] and speculations [Hogarth, 1980], as well as limited empirical evidence [Mitchell and Kalb, 1981], that outcome information can affect performance evaluations, no accounting study has directly investigated the impact of outcomes on performance evaluations.[1]

The objective of this paper is to experimentally examine potential effects of outcome information on evaluations of managerial decisions. Managerial decisions are investigated because managers typically are removed from the phenomena of interest and must rely on internal accounting and managerial information

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[1] While not directly related to the impact of outcome information, accounting researchers have examined performance evaluation and the role of accounting within that process. Various expectancy models, for example, have been used to investigate the effects of a number of individual and situational variables (e.g., evaluation policies, leadership style, evaluatee characteristics, performance criteria accuracy, job standard tightness, and compensation schemes) on performance evaluations

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systems when evaluating other managers' decisions. Thus, accounting has greater impact on managerial decision evaluations than on evaluations of more physical, work-related tasks which have been examined in prior research.

The experiment reported in this paper was designed specifically to test both the extent to which outcomes affect evaluations of managerial decisions and if such effects are attenuated by two hypothesized factors. The experimental task involved individuals' evaluations of a capital budgeting committee's decision to fund a particular proposal. Primary results were that outcome knowledge affected evaluations of the committee's funding decision, but as hypothesized, such an effect was attenuated by: (1) the evaluator's prior involvement with the committee's decision process, and (2) the extent to which the reported outcome implied that the committee was responsible for anticipating the outcome. As discussed below, these results suggest that information system design and outcome attributes can affect the extent to which appraisals of managerial decisions are based on an evaluation of outcomes rather than an evaluation of the process of deciding.

The next section of this paper discusses outcome information in the context of appraising managerial decisions and thereby provides the conceptual background for the study. The section concludes with a statement of the hypotheses to be tested experimentally. The third section describes the method of the experiment, while results of both hypothesis tests and supplemental analyses are presented in the fourth section. Concluding remarks complete the paper.

OUTCOME INFORMATION AND EVALUATIONS OF MANAGERIAL DECISIONS

Possible effects of outcome information on evaluations of managerial decisions are discussed below. A normative perspective is adopted in the first subsection, while later subsections adopt a descriptive (cognitive) perspective.

Normative Effects of Outcome Information

Formal decision theories, such as expected utility theory, hold that the process of deciding should conform to a set of axioms which ensure that individuals' decisions (or choices based on decisions) maximize expected utility from outcomes. From the perspective of these theories, decision processes, to the exclusion of outcomes, are relevant for assessing decision quality.[2] In certain instances, however, outcomes may be valid inputs to assessments of decision quality. Specifically, when decision processes are not observable by the evaluator, outcomes can serve as cues to the decision processes that were used by managers.[3]

(e.g., Kida [1984]) and on performance (e.g., Brownell and McInnes [1986]). Contingency models also have been used to examine the effects of congruity between situational and individual characteristics (e.g., task uncertainty, reliance on accounting performance measures, organizational variables, information systems, and performance evaluation style) on performance (e.g., Govindarajan [1984]). Additionally, attribution theory has been used to examine factors affecting attributions of performance cause (e.g, Shields et al. [1981]). Finally, Brownell [1982] used operant conditioning and consistency theory to examine mediating effects of budgetary participation on evaluation style and performance, while Hopwood [1972] and Otley [1978] examined the effects of evaluation style on performance.

[2] This perspective is consistent with the agency theory view that when the agent's efforts (in the present case, the manager's decision process) are perfectly observable, the first-best solution for incentive contracting is to base incentives on those efforts, to the exclusion of outcomes [Holmstrom, 1979].

[3] This statement is consistent with the agency theory view that the second-best solution for incentive contracting is to base incentives on outcomes when the agent's efforts are unobservable. However, when the manager's efforts are imperfectly observable, the second-best solution is to base incentives on both efforts and outcomes [Holmstrom, 1979].

Managerial decision evaluations should be affected by outcomes if, for example, such outcomes suggest that the manager inappropriately considered extant relevant information (e.g., ignored prior probabilities or underweighted contradictory evidence). Similarly, outcomes should affect managerial decision evaluation if they indicate that the manager took into account relevant information which the evaluator either did not consider *ex ante* or did not credit the manager with considering.

Cognitive Effects of Outcome Information: The Extant Psychology Literature

Fischhoff [1975], Fischhoff and Beyth [1975], Slovic and Fischhoff [1977], and Fischhoff [1977] report data consistent with what psychologists have labeled *hindsight bias*. Specifically, subjects who were told that a particular outcome occurred (hindsight subjects) assigned to that outcome a significantly higher probability of occurrence than subjects who were not told an outcome had happened (foresight subjects). Similar hindsight bias results have been obtained in a number of medical settings involving judgments by nurses [Mitchell and Kalb, 1981], patients [Pennington et al., 1980], surgeons [Detmer et al., 1978], and physicians [Arkes et al., 1981].

Several explanations for hindsight bias have been advanced. Fischhoff [1975] and Hogarth [1980], for example, propose that outcome knowledge restructures memory. Thus, memory is less a remembrance of past uncertainties than a reconstruction of the past in light of known outcomes. Similarly, Nisbett and Ross [1980] speculate that hindsight bias is a function of the limited availability of causal scenarios for alternative outcomes *vis-a-vis* scenarios for the reported outcome. Einhorn and Hogarth [1981a] also suggest that hindsight bias results from individuals' "fluency of diagnostic thinking." That is, outcome information facilitates the generation of a coherent story and, once generated, forward inference (i.e., prediction of outcomes) involves less uncertainty since the multiplicity of causation has been reduced (i.e., the minimally sufficient conditions for outcomes that do not involve the coherent story have been reduced). Finally, others (cf., Ross and Sicoly [1982]) suggest that motivational factors may play a role since, to preserve both their self-images and how they are perceived by others, judges, in hindsight, may be motivated to act as if they always knew what was going to occur.

Cognitive Effects of Outcome Information: Evaluations of Managerial Decisions

The psychological phenomenon of hindsight bias in probability judgments suggest that outcome information may affect appraisals of managerial decisions [Hogarth, 1980; Mitchell and Kalb, 1981]. In particular, when managerial decisions are evaluated after the results of those decisions (outcomes) are known to the evaluator, knowledge of the outcome may influence evaluators' assessments. As indicated earlier, the appropriateness of such effects depends on the observability of the evaluatee's decision process. Thus, unlike the psychological studies, effects of outcome information on appraisals of managerial decisions cannot be unambiguously labeled a bias. It is more informative, therefore, to study factors that may attenuate or amplify the effects of outcome information on such appraisals, as opposed to simply documenting the existence of the effect. In the experiment described below, documentation of a basic outcome information effect provided a standard, or base-line, by which the power of hypothesized factors to attenuate such an effect could be measured.

Although a potentially large number of factors could attenuate the effects of outcomes on evaluations of managerial decisions, two such factors were examined: (1) the evaluator's advisory involvement with the evaluatee's decision process prior to judging the evaluatee's performance, and (2) the extent to which the reported outcome implies that the evaluatee was responsible for anticipating the outcome. These factors were selected primarily because cognitive considerations strongly suggest that they would significantly reduce the effects of outcomes on managerial decision evaluation (discussed below). Further, prior advisory involvement is an aspect of performance evaluation that is largely under the control of senior management (and senior management's advisors, such as accountants) when structuring performance evaluation systems.

Prior Advisory Involvement. The aforementioned psychological explanations of hindsight effects on probability judgments are consistent both in their predictions that evaluations of managerial decisions, without prior involvement, will be affected by outcomes and that, within a prior involvement structure, diminished outcome effects will be exhibited. Without prior involvement, the evaluator has not experienced the thought associated with decision making at a point in time when outcomes are *unknown*. Thus, outcome knowledge becomes the evaluator's most available information with which he or she "reconstructs" a plausible causal scenario. Such a scenario, by reducing the multiplicity of causation, reduces the level of uncertainty that the evaluatee is perceived to have faced.

With prior involvement, however, the evaluator should be less affected by outcome information. First, evaluators who have prior involvement with the evaluatee's decision process should be in a better position than evaluators not previously involved to perceive the degree of uncertainty the evaluatee faced when making the decision concerning the course of action to be taken [Fischhoff, 1976]. Thus, previously involved evaluators, having experienced this uncertainty, should be less likely to reconstruct the past solely in light of the reported outcome. Second, considering alternative decisions *prior* to knowledge of outcomes should increase the availability, to the previously involved evaluator, of alternative causal scenarios and thus, increase the multiplicity of causation. This, in turn, should increase the level of perceived uncertainty. Finally, when an evaluator has advised an evaluatee to take a particular action and the recommended action is taken, even if subsequent events suggest that an alternative action would have resulted in a more desired outcome, the prior advice should inhibit the evaluator from adopting the position that he or she "knew all along" that an alternative action should have been taken.

Outcome Anticipation Responsibility. For knowledgeable individuals, different combinations of circumstances could have different meanings and thus, in hindsight, imply different plausible causal scenarios, different levels of responsibility for anticipating outcomes, and different performance evaluations. Attribution theory (see Kelley and Michela [1980] for a review) postulates that causal attributions (to situational and/or personal factors) are influenced by evaluators' expectations about actors (evaluatees) and about behavior in situations (decisions). Additionally, in a summary of the literature on unexpected performance outcomes, Zuckerman [1979] found the majority of the evidence to be consistent with the notion that unexpected outcomes are attributed less to individual abilities than to luck or chance. A cue to the level of responsibility for anticipating outcomes, therefore, could be the prior probabilities associated with those outcomes. Reported outcomes that were thought to be unlikely could suggest that the evaluatee was less responsible for anticipating the occurrence of that outcome.

Similarly, the source of prior probability estimation could be a cue to the evaluatee's responsibility for anticipating outcomes. For example, an evaluatee could be perceived to be less responsible for not anticipating a low prior probability outcome when that prior probability was assessed by another person (who is at least as expert as the evaluatee), than when the prior probability was assessed by the evaluatee. There is, however, considerable evidence in the psychological literature suggesting that, in performance evaluation contexts, negative information is weighted more heavily than positive information (see DeNisi et al. [1984] for a review of this literature). Thus, although the effect of outcomes on evaluations of managerial decisions should be greater when outcomes imply that the evaluatee had greater anticipation responsibility, such an effect in the case of a success may not be as strong as in the case of a failure.

Hypotheses. Three alternative-form hypotheses follow directly from the previous discussion and were tested experimentally as described in the subsequent section. Hypothesis one is a "base-line" prediction, whereas hypotheses two and three may be viewed as "attenuating factor" predictions.

H1: Evaluations of managerial decisions will be significantly affected by outcome information when the evaluator has no prior involvement with the evaluatee's decision process and the reported outcome implies that the evaluatee had relatively higher responsibility for anticipating the outcome.

H2: The effect of outcome information on evaluations of managerial decisions will be significantly smaller when the evaluator has prior involvement with the decision being evaluated, than when no prior involvement exists.

H3: The effect of outcome information on evaluations of managerial decisions involving failures will vary in direct relation to the extent to which the reported outcome implies that the evaluatee was responsible for anticipating the outcome.

THE EXPERIMENT

The hypothetical managerial decision evaluation case used in the experiment was developed by the researchers. It described a capital budgeting project involving the proposed addition of a videocassette movie rental library to the electronics departments of a chain of retail department stores. Subjects were asked to assume the role of an assistant controller for the company, and were instructed that one of their responsibilities was to help a corporate committee evaluate capital budgeting proposals and projects (either *ex ante* or *ex post* to the committee's capital budgeting decisions).

Subjects

The subjects were 96 upper-level undergraduate and master's level graduate students enrolled in a cross-section of the disciplines in the business college of a major university. Recruited on a volunteer basis, the subjects were randomly assigned to experimental conditions (discussed below), with the constraint that cell sizes were approximately equal.[4] Student-subjects were considered satisfactory for the present study because their formal business education (e.g., knowledge of various economic models that underlie business decisions, in general, and capital budgeting decisions, in particular) should have provided sufficient knowledge with which to construct plausible scenarios for alternative outcomes in capital budgeting contexts.

Independent Variables

Two between-subjects independent variables were used in this study. One of these variables, at four levels, was the reported outcome of the capital budgeting project: no outcome reported (foresight), project failure due to a change in the federal copyright law, project failure due to economic factors (e.g., average daily rentals and price elasticity of consumer demand), and project success. The reported outcomes were presented as causal scenarios describing the events that occurred during the three-year period subsequent to the project's implementation.

Two of the four levels of the reported outcome variable (the two failure outcomes) were more complex than indicated above. Specifically, these levels contained a nested manipulation of the extent to which the reported outcome implied that the evaluatee was responsible for anticipating the outcome. This nested manipulation was operationalized by jointly varying prior probabilities and information sources. In particular, the prior probability of failure due to a change in the federal copyright law was incorporated within the case write-up and described as being both low and significantly less than the prior probability of failure due to economic factors or the prior probability of project success. Further, the source of this information was an "outside expert," the company's attorney, whereas the source of the information about the economic factors largely was the company's marketing research director. Thus, the capital budgeting committee should have been perceived as less responsible for not anticipating a failure due to a change in the federal copyright law than for not anticipating a failure due to economic factors or for not anticipating project success.

The second between-subjects independent variable, at two levels, was the subject's involvement with the capital budgeting committee's decision: prior involvement or no prior involvement. Prior involvement was operationalized as a series of questions asked by the capital budgeting committee and answered by subjects *prior* to their knowledge of the committee's decision and the outcome (if any) and *prior* to their evaluation of the committee's capital budgeting decision. These questions asked the prior involvement subjects to: (a) assess the overall probability that the capital budgeting committee should estimate for the video movie rental project to fail as a business venture (i.e., to produce a pretax ROI of less than 15 percent per year); (b) list and estimate the probability of the three possible causes that the capital budgeting committee should consider as the most likely to result in the failure of the proposed project; and (c) indicate, assuming membership on the capital budgeting committee, whether the subject would vote to approve the video movie rental project for implementation.

[4] Told that a panel of experts had solved the case and that "best" performance was the mean of that expert panel's evaluation, the subjects were offered competitive prizes ($100, $75, $50, $25) for the four best performances.

In the no-prior-involvement conditions, subjects were asked these questions *after* their knowledge of the committee's decision and the outcome (if any) and *after* their evaluation of the committee's capital budgeting decision. Additionally, the questions were framed in the past tense and requested the no-prior-involvement subjects to respond from the perspective of the time at which the committee made its decision.

Dependent Variable

All subjects were asked to indicate how strongly they believed that the capital budgeting committee's approval of the video movie rental project was a significant judgment error by responding to the following question.

> How strongly do you believe that the capital budgeting committee's decision to approve the video rental project, *at the time they made it*, was a significant error in judgment?

The response was elicited on an 11-point scale which, for analysis, was transformed to a 100-point scale, where zero was a very strong belief that the committee's decision was *not* a significant judgment error and 100 was a very strong belief that the decision was a significant judgment error.[5] The effect of outcome information is measured as the difference in the evaluations of the foresight and the hindsight subjects (i.e., evaluations with and without knowledge of outcomes).[6]

Procedures

The subjects were given a copy of the capital budgeting case prior to attending their experimental session. The case included background information on the company and on the subject's role as an assistant controller, and an abstract of the videocassette movie rental proposal that had been prepared by the company's director of marketing research. The proposal abstract included information on market growth potential, pricing of daily rental fees, average daily rental statistics, price elasticity of consumer demand, market share and competition, proposed changes in the federal copyright law and possible effects on fees paid to movie studios, projected pre-tax return on investment, and proposed course of action. The case concluded by instructing the subjects to have thought, prior to the experimental session, about possible causes of the project failing to produce the company's minimum desired ROI (15 percent annual pre-tax), as well as to have assessed the likelihoods of such causes.

Subjects completed the experimental session at their own pace, within a total time constraint of 60 minutes. The experimental instructions, stimuli, and tasks were presented on personal computers located in a 20-machine laboratory. The instructions included a brief explanation on the use of the personal computer, followed by a sample problem designed to acquaint the subject with question answering (both prosaically and numerically) on the computer.

The experiment continued with the subject's responses to the involvement questions and evaluation of the committee's capital budgeting decision. The order of these two tasks depended on the subject's randomly assigned level of the involvement variable. Subjects in the prior-involvement level responded to the involvement questions prior to learning the committee's decision and the outcome (if any) and prior to evaluating the committee's decision, whereas subjects in the no-prior-involvement level performed these tasks in the opposite order. The session concluded with a post-experiment questionnaire, also presented on the computer. A schema of these procedures is presented in Figure 1.

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[5] The response scale ranged from -5 to $+5$, and the transformation was accomplished by adding five to each subject's evaluation and then multiplying this sum by ten.

[6] The algebraic sign of the effect of outcome information, as measured in this study can be either positive or negative. Since the outcome effect is a change, once outcomes are known, in decision performance evaluation toward the valence of the outcome, a more *negative* decision performance evaluation will result, in light of revealed failure, than without such outcome knowledge. Analogously, a more *positive* decision performance evaluation will result in light of revealed success than without knowledge of the outcome.

RESULTS

The first three subsections below present test results for each of the hypotheses, while the last subsection presents supplemental analyses designed to indicate whether differences between the foresight and hindsight performance evaluations are more indicative of a bias than an appropriate outcome effect. Planned comparison procedures, rather than analysis of variance, were used to test the hypotheses. The former are preferable since the hypotheses, stated *a priori*, involve point estimates and partial interactions, rather than main effects and complete interactions.

"Base-line" Outcome Information Effect (*H1*)

Hypothesis one predicts that managerial decision evaluations will be significantly affected by outcome information when the evaluator has no prior involvement with the evaluatee's decision process and relatively higher anticipation responsibility is implied. Within the no-prior-involvement condition, foresight judgments were contrasted with the hindsight judgments for the two reported outcomes which implied higher anticipation responsibility (failure due to economic factors and success). Table 1 presents the results together with descriptive statistics. The results indicate that the outcome effect in both comparisons is significantly different from zero. Thus, hypothesis one is confirmed.

Prior Involvement (*H2*)

Hypothesis two predicts that the effect of outcome information on evaluations of managerial decisions will be significantly smaller when the evaluator has prior involvement with the decision being evaluated than when no prior involvement exists. To test this hypothesis, the sum of the absolute outcome effect in the no-prior-involvement conditions was contrasted to that in the prior-involvement conditions. The comparison, also presented in Table 1, indicates that within the prior-involvement conditions, outcome effects are significantly smaller than those in the no-prior-involvement conditions, confirming hypothesis two. Moreover, further analysis indicates that within each prior-involvement condition (hypothesized to exhibit smaller effects), the outcome effect is not significantly different from zero ($F=0.026$ with 1,88 d.f.).

Anticipation Responsibility (*H3*)

Hypothesis three predicts that the effect of outcome information on evaluations of managerial decisions involving failures will vary in direct relation to the extent to which the reported outcome implies that the evaluatee was responsible for anticipating the outcome. Implicit in this hypothesis is that the capital budgeting committee was perceived as less responsible for not anticipating a failure due to a change in the copyright law than for not anticipating a failure due to economic factors or for not anticipating project success. A manipulation check was performed to test this assumption. Specifically, a different, but similar, group of 34 subjects were asked to assess, on a ten-point

FIGURE 1

SCHEMA OF THE EXPERIMENTAL PROCEDURES

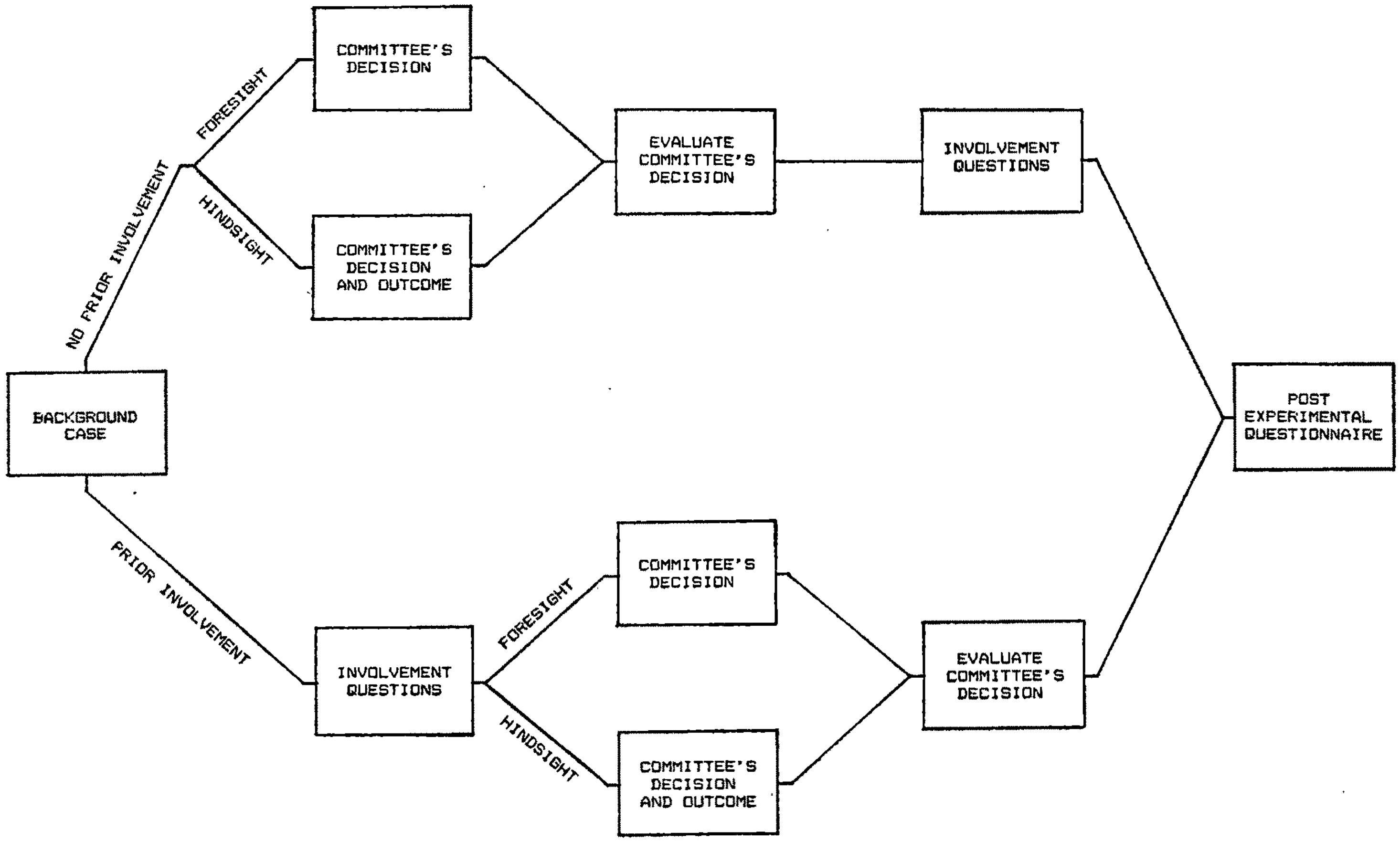

TABLE 1

SUBJECTS' BELIEFS THAT THE COMMITTEE MADE AN ERROR IN JUDGMENT

DESCRIPTIVE STATISTICS:

Evaluator Involvement	*Reported Outcome*	*Mean*	*Standard Deviation*	N
None	Foresight	40.00	25.14	12
None	Hindsight:			
	Failure (Law Change)	48.75	32.34	12
	Failure (Economics)	71.25	21.96	12
	Success	17.92	8.38	12
Prior	Foresight	32.92	34.54	12
Prior	Hindsight:			
	Failure (Law Change)	36.67	30.77	12
	Failure (Economics)	37.69	31.73	13
	Success	32.27	33.27	11

PLANNED COMPARISONS:

Comparison	*Mean*	*Standard Error*	t	p
Hypothesis 1:				
PE(NPI,FS) − *PE(NPI,FE)*	−31.25	11.54	−2.708	<.004[a]
PE(NPI,FS) − *PE(NPI,S)*	22.08	11.54	1.913	<.028[a]
Hypothesis 2:				
$\sum^{RO}[\lvert PE(NPI,FS)-PE(NPI,RO)\rvert - \lvert PE(PI,FS)-PE(PI,RO)\rvert]$	52.91	23.10	2.290	<.023[b]
Hypothesis 3:				
PE(NPI,FE) − *PE(NPI,FLC)*	22.50	11.54	1.949	<.051[b]

Note: *PE*=Performance Evaluation; *NPI*=No Prior Involvement; *PI*=Prior Involvement; *FS*=Foresight; *FLC*=Failure (Law Change); *FE*=Failure (Economics); *S*=Success; and *RO*=Reported Outcomes. Each *t*-statistic has 88 d.f., and the reported probability values are:

[a] one-tailed

[b] two-tailed

scale, the extent to which the capital budgeting committee was responsible for anticipating a possible outcome. These subjects were not told the committee's decision, nor were they told the outcome of that decision. Randomly assigned, they considered one of three *possible* event outcomes (Congress would change the federal copyright law, consumer demand would be well below that estimated in the proposal, and events would occur as estimated in the proposal). The mean anticipation responsibility assigned to the law change was 3.5, whereas the mean of that assigned to the other two possible events was 6.41. These means are significantly different ($t=3.058$ with 32 d.f., $p<.005$ one-tailed) in the direction consistent with the assumption.

To test hypothesis three, the outcome

effect exhibited by subjects given the failure due to a change in the copyright law condition (which was perceived to imply lower anticipation responsibility), was compared with that of subjects given the failure due to economic factors condition (which was perceived to imply higher anticipation responsibility).[7] Presented in Table 1, this comparison indicates that when a reported failure implies lower anticipation responsibility, the outcome effect is significantly smaller than when a reported failure implies higher anticipation responsibility. Hypothesis three is confirmed by these results.

Probability Assessments

The effect of outcome information on evaluations of managerial decisions, as previously noted, generally cannot be unambiguously interpreted as a bias. Subjects' assessments of failure probabilities, however, can be used to determine whether the observed outcome effects were at least partially reflective of a bias. Although outcome information may be a valid input for performance evaluations, posterior probabilities, not prior probabilities, should be affected by such information. When evaluations of managerial decisions are based, in part, on prior probability assessments (as suggested by hypothesis three), biased prior probability assessments can produce biased performance evaluations. Thus, if outcome information were to have similar effects on both managerial decision evaluations and prior probability judgments, the likelihood is increased that such effects at least partially reflect a bias.

Prior probabilities of overall project failure and of failure due to each of the three most likely causes (as perceived by the subjects) were assessed by the subjects as part of their involvement questions (see the above "Independent Variables" description for more detail). The prior probability of overall project failure, for example, was assessed by responding to the following question.

> In your judgment, what is the overall probability that the capital budgeting committee should have estimated, *at the time they made their decision*, for the video movie rental project to *fail* as a business venture (i.e., to produce a pre-tax ROI of *less* than 15 percent per year)?[8]

The response was elicited on a 100-point scale, where zero was no probability of failure (i.e., success with certainty) and 100 was failure with certainty (i.e., no chance of success).

Over all reported outcomes, subjects in the prior-involvement condition (i.e., subjects who assessed probabilities *before* knowledge of the committee's decision and the outcome of that decision) exhibit no significant outcome effects in either their prior probability assessments (not reported, but all t-statistics are less than 1.0) or their performance evaluations (see Table 1). However, the prior probability assessments of subjects in the no-prior-involvement condition (i.e., subjects who assessed probabilities *after* knowledge of the committee's decision and the outcome, if

[7] Since the results indicate that no significant outcome effect exists when the evaluator was previously involved, that level has been dropped from the hypothesis 3 comparison.

[8] The use of the word "should" suggests the possibility that the capital budgeting committee should have searched for additional relevant information that was marginally diagnostic of the outcome and again the outcome should be considered in the assessment. Perhaps a better wording would have been, "In your judgment, what would the capital budgeting committee, at the time they made their decision, have estimated the probability of the video movie rental project failing as a business venture? Answer this question assuming that you did not know the outcome."

any) exhibit outcome effects similar to those exhibited by their performance evaluations.[9] Overall, such results appear consistent with at least a partial bias interpretation for the observed effects of outcome information.

CONCLUDING REMARKS

As with any laboratory experiment, there are a number of limitations inhibiting generalizability to contexts outside of our laboratory. These limitations include the use of students as subjects, use of a hypothetical performance evaluation task, choice of variable manipulations, and potential framing effects caused by the instructions that subjects consider potential causes of *failure* rather than success. Notwithstanding these limitations, the present study has demonstrated that (1) evaluations of managerial decisions can be affected by outcome information, and (2) certain factors can attenuate the effects of outcome information on such evaluations.

Within our experimental context, significant differences between foresight and hindsight performance evaluations were observed when the evaluator had no prior involvement and the reported outcome implied that the evaluatee had relatively higher responsibility for anticipating the outcome (i.e., failure due to economic factors and success). However, no such differences were observed when the evaluator had prior involvement or when the reported outcome implied that the evaluatee had relatively lower responsibility for anticipating the outcome (i.e., failure due to a change in the copyright law). Because strictly appropriate decision evaluations are not identifiable within our experimental setting, the observed outcome effects could be either appropriate or a bias. Based on analyses of prior probability assessments (see footnote 8 for a possible ambiguity), the results appear to support at least a partial bias interpretation.[10] However, irrespective of the extent to which the evaluations are biased, the study has demonstrated that prior involvement and implied responsibility for anticipating outcomes can affect the extent to which appraisals of managerial decisions are based on an evaluation of outcomes rather than an evaluation of the process of deciding.

A focus of hindsight bias research in psychology has been that of numerous "debiasing" strategies (i.e., techniques to eliminate/reduce the effects of outcomes on prior probability judgments). However, none of these strategies has been successful in eliminating outcome effects and only one has reduced it. Summarizing this literature, Fischhoff [1982b, p. 431] made the tentative general statement, "It (hindsight bias) appears to be quite robust and widespread. Reducing it requires some understanding of and hypotheses about people's cognitive processes." The present study, however, identifies conditions in which the effects of outcome information on managerial decision evaluations systematically were reduced (eliminated). Therefore, a final implication of our experimental results involves the process of generalizing psychological research findings into accounting contexts. Specifically, our results may be interpreted as an experimental illustration of the proposition that contextual factors (in the present case, the extent of prior involvement) significantly influence psychological processes underlying judgments and decisions (cf., Einhorn and Hogarth [1981b]). Consistent with Demski and Swieringa's [1981] notion concerning accountants' comparative advantage in judgment/decision research, therefore, future behavioral accounting researchers should consider *ex ante* the effects that accounting contexts themselves may have on subjects' judgments, decisions, and underlying cognitive processing.

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[9] Similar outcome effects arose when the reported failure implied higher evaluatee anticipation responsibility; significant for performance evaluations (see Table 1), but not significant for prior probability assessments (results not reported; $t=-1.415$; 22 d.f., $p<.084$). Additionally, similar outcome effects arose when the reported outcome was project success; significant for both performance evaluations (see Table 1) and prior probability assessments (results not reported; $t=2.004$; 22 d.f., $p<.028$). No significant outcome effects arose, however, in either the prior probability assessments (results not reported; $t<1.0$) or the performance evaluations (see Table 1) when the reported outcome implied lower evaluatee responsibility for anticipating the outcome (i.e., failure due to a law change).

[10] It should be noted that if the outcome effect is considered to be completely appropriate, then the conditions that resulted in no such effect reflect bias.

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An Empirical Study of Audit Committee Support for Auditors Involved in Technical Disputes with Client Management

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ABSTRACT: Critics allege that audit committees often fail to mitigate management pressure on auditors when disputes arise during an audit. The objective of this study is to investigate factors that may affect the likelihood that audit committees will support auditors, rather than management, in audit disputes. A repeated measures experiment was conducted using 179 audit committee members as subjects. Analysis of variance results show that backgrounds of audit committee members may be predictive of their willingness to support auditors involved in disputes with client management. Also, two contextual variables seem important—whether the relevant professional standards are objective and the relative financial condition of the audited firm.

CONSIDERABLE attention has been focused recently on the relation between audit firms (auditors) and their clients (auditees). Investigations in the mid-1970s by Congress [U.S. Senate, 1977] and the AICPA-sponsored Cohen Commission [AICPA, 1978] pointed to a number of apparent inconsistencies in stated objectives of the independent audit function and the manner in which that function is structured. In this vein, several researchers have expressed concern that the inherent imbalance of power in the audit context may permit client management to extract important concessions from their external auditors [Goldman and Barlev, 1974; Nichols and Price, 1976; DeAngelo, 1981]. A recent empirical study suggests that client management's perceived ability to influence the reporting behavior of auditors may be damaging the credibility of the independent audit function [Knapp, 1985].

One response to criticism that auditors sometimes cater to the economic interests of their clients was a move to establish audit committees to serve as liaisons between management and auditors. According to the Cohen Commission, a board of directors that includes outside

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directors and an audit committee "is the best vehicle for achieving and maintaining balance in the relationship between the independent auditor and management" [AICPA, 1978, p. 106]. Within the last decade, efforts of the Securities and Exchange Commission and the New York Stock Exchange have led to widespread adoption of audit committees. Effective June 30, 1978, companies with common stock issues registered on the New York Stock Exchange (NYSE) were required by the NYSE to have an audit committee in operation.[1] Four years later, a study by the Securities and Exchange Commission (SEC) [1982] found that approximately 86 percent of SEC registrants had formed audit committees.

Recently, the ability and motivation of audit committees to serve as active and objective intermediaries in audit conflicts have been questioned. A series of "audit failures," in which auditors allegedly capitulated to the demands of overzealous clients [Morris, 1982; Klott, 1984; Weiss, 1985], has resulted in charges that audit committees often fail to intervene in audit disputes, thus allowing management to exert undue pressure on auditors. Former SEC Commissioner James C. Treadway has commented on the need for "heightened responsibility by the audit committee" [Coopers & Lybrand, 1984, p. 14] and noted that inordinate pressure on independent auditors sometimes results from "management stubbornness . . . and audit committees [who] do not exercise proper care or who do not have adequate sensitivity" [AIPCA, 1984, p. 5].

The objective of this study is to investigate factors that may affect the willingness of audit committees to support auditors involved in technical disputes with client management. A review of the relevant literature identified the following factors that may inhibit audit committee support for auditors in such situations: backgrounds of audit committee members, size class of the audit firm, nature of the conflict issue, and the auditee's relative financial condition. Knowledge of the effects of these factors should provide a better understanding of the role of audit committees in the audit process.

DEVELOPMENT OF RESEARCH HYPOTHESES

Audit Committee Members' Background

To promote the independence of corporate audit committees, the SEC and NYSE have encouraged firms to appoint only outside directors to the audit committee.[2] According to the 1982 SEC study, only 13 percent of the positions on corporate audit committees in 1981 were held by officers of the firm or officers of affiliated firms. Even though the SEC and NYSE strongly support this staffing policy, critics have expressed concern that corporations tend to appoint outside directors who have little or no inclination to oppose important positions of management [Dentzer, 1985; Baum, 1986; Bennett, 1986]. In a related argument, Goldman and Barlev [1974] maintain that because audit committee members are selected by management, auditors often fail to receive adequate support from audit committees when major audit disputes occur.

An analysis of 149 annual reports in connection with this study found that audit committee members tend to be either officers of other public firms, individuals from a nonbusiness background, or retired officers of other public firms. Wallace [1985] argues that individuals drawn from the latter two groups tend to be reluctant to participate actively and objectively in the corporate oversight role. Lay directors often do not possess the requisite expertise to evaluate important technical issues [Baum, 1986], and as a result, may simply approve proposals of the officers who appointed them. Retired business executives may lack a thorough understanding of current accounting and reporting issues and may not have the necessary economic incentives to become actively involved in policing management.[3] Conversely, audit committee members who are managers of public firms should be well versed in current accounting and reporting issues. In addition, the livelihood of a corporate manager, as compared to that of a retired executive or lay audit committee member, is more likely to be damaged by association with an audit failure. Consequently, corporate managers who serve on audit committees may have a stronger economic incentive to participate actively and objectively in the corporate oversight role.

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[1] This is currently the only formal requirement mandating that publicly owned firms establish audit committees.

[2] The NYSE prohibits registrants from appointing their officers to the audit committee, while the SEC has discouraged this practice by requiring registrants to disclose whether any audit committee members are affiliated with the firm.

H1: Audit committee members who are corporate managers are more likely to support an auditor involved in a major dispute with client management than are audit committee members who are not corporate managers.

Audit Firm Size Class

Several researchers maintain that the quality of Big Eight audits is generally higher than that of non-Big Eight audits. Watts and Zimmerman [1981] argue that the large national firms provide more effective quality control over their audits. McConnell [1984, p. 55] suggests that Big Eight firms may be "more careful," while Eichenseher and Shields [1985, p. 14] contend that "the expected quality of a Big-Eight audit tends to exceed that of a non-Big-Eight audit." If there is a difference in audit quality, audit committees may impute more validity to the position of a Big Eight firm auditor involved in a dispute with management.

Audit committees generally prefer Big Eight auditors not only for audit quality considerations but also because Big Eight auditors are capable of absorbing a greater portion of potential litigation losses than non-Big Eight auditors [Eichenseher and Shields, 1985]. That is, audit committee members can limit their potential litigation losses to a greater degree when the auditor is a Big Eight firm. This "insurance" factor provides an additional motive for audit committee members to be more willing to support an auditor involved in an audit dispute when the auditor is a Big Eight firm.

H2: Audit committee members are more likely to support an auditor involved in a major dispute with management when the auditor is a Big Eight as opposed to a non-Big Eight firm.

Objectivity of Professional Standards

The subjective nature of many technical standards has been a primary focus of the audit conflict literature. Nichols and Price [1976] assert that moves to increase the routinism of the audit function, such as more explicit specification of technical standards, would improve the credibility of audits as well as provide auditors more bargaining leverage in technical disagreements with clients. Those contentions were empirically supported in studies by Knapp [1985] and Monger [1981]. Loan officers in Knapp's study perceived that auditors are more resistant to management pressure in audit conflicts when the conflict issue is precisely addressed by technical standards. Monger's study demonstrated that explicitly defined technical standards cause management to be less likely to question or attempt to influence auditors' decisions.

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[3] Wallace [1985] maintains that retired business executives may perform poorly as corporate directors because they have little to risk in terms of professional reputation or future livelihood.

The degree of precision with which technical standards address the focal issue of an audit dispute may also affect the motivation of audit committee members to support auditors in conflict situations. When an auditor's position is clearly supported by technical standards, audit committee members will likely feel pressured to support that position.

> H3: Audit committee members are more likely to support an auditor involved in a major dispute with management when the focal issue is the subject of objective technical standards.

Financial Condition of Auditee

The client firm's relative financial condition may affect incentives for the firm's audit committee members to support the auditor in an audit dispute. The potential legal liability of directors, like that of auditors, has risen dramatically in recent years [Eichenseher and Shields, 1985; AICPA, 1986]; this potential liability is especially high when a firm is in poor financial condition [Hilder, 1985]. The increased legal exposure audit committees face when their firm is in weak financial condition provides audit committee members a stronger motivation to support the auditor in an audit conflict and thereby demonstrate that they have discharged their fiduciary responsibilities.

> H4: Audit committee members are more likely to support an auditor involved in a major dispute with management when the auditee is in weak, as opposed to strong, financial condition.

RESEARCH METHOD

Subjects

Subjects were drawn from the audit committees of firms listed in the 1985 "California 500," a compilation of the 500 largest publicly owned corporations in California [McCue, 1985]. Two hundred of the California 500 firms were randomly selected and asked to provide a copy of their 1985 annual report. From this set, 149 usable annual reports were obtained.[4] Audit committee members of the firms providing their annual reports were divided into two groups: the 355 individuals who were members of management of unrelated firms (managers) and the 181 individuals without such affiliation (non-managers).[5] Each of the individuals in the latter group and 181 randomly selected individuals in the former group were mailed research instruments. Usable instruments were returned by 87 of the managers and 92 of the non-managers, representing a response rate of approximately 50 percent for each group.

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[4] The annual reports of certain firms were excluded for the following reasons: the annual report was not available on a timely basis; the annual report did not identify the audit committee; or, in the case of non-NYSE firms, the firm did not have an audit committee.

[5] The 181 individuals who were not managers of public firms came from the following backgrounds: retired executives of other public firms (36 percent); present or former college administrators and college professors (26 percent); former military, government, and political figures (eight percent); attorneys (eight percent); clerics and executives of non-profit organizations (six percent); financial consultants (four percent); technical industry specialists (three percent); executives of private firms (three percent); other (six percent). Individuals affiliated with their firms, other than strictly as directors and members of the audit committee, were excluded from the list of prospective subjects.

The subjects responded to four supplemental questions included in the instrument. For each group of subjects, the average number of audit committee meetings per year was 3.6 and the average length of service was approximately 7.0 years. The mean number of audit committee appointments for the managers was 2.74, and for the non-managers 1.86. Finally, a substantial percentage of each group had been involved in the resolution of auditor-management conflicts which suggests that audit committees, as intended by regulatory authorities, often mediate such disputes. As a group, 69 percent of the managers reported they had been involved in auditor-management dispute resolution while the comparable measure for non-managers was 50 percent. This difference is probably attributable to the larger number of audit committee appointments for the corporate manager subjects.

Experimental Task

The subjects were asked to respond to eight randomly ordered cases describing auditor-management conflicts.[6] Each subject was instructed to assume that he or she was a member of the audit committees of the companies involved in the disputes and that the audit committee, in each case, had been asked to arbitrate the dispute. The subjects were required to report the likelihood that they would support the auditor, rather than management, in each of the eight cases. A seven-point, equal-interval Likert scale was used by the subjects to record their responses. To support the assumption of equal intervals, only the two endpoints on the scale were captioned [Torgerson, 1958].[7]

One-half of the cases focus on a conflict issue, the disclosure of subsequent events, for which there is an objective technical standard [SAS 1, 1985, Section AU 560.05-.06]. The standards clearly support the stance taken by the auditor in those cases—disclosure of the event. The remaining cases involve a dispute over the materiality of a financial statement amount, an issue not dealt with as explicitly by technical standards.[8] The auditor believes an adjustment is necessary for the disputed amount, but technical standards do not provide explicit, authoritative support for that position. The final two factors varied across the eight cases were also dichotomous. Subjects were informed that the auditor was either a Big Eight firm or a non-Big Eight firm. An auditee was described as in either strong financial condition or in financial distress. Figure 1 summarizes the treatment levels of each factor and the Appendix provides an example of how the treatment levels were narratively presented to the subjects.[9]

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[6] The research design implicit in the research instrument was a repeated measures, fixed-effects ANOVA model with one between-subjects factor, subject background, and three within-subject or repeated factors. For a detailed discussion of repeated measures designs involving one between-subjects factor and multiple within-subject factors, see Winer [1971, pp. 539-559].

[7] The multiple stimulus procedure used in a related study by Shockley [1981] and described originally by Torgerson [1958, pp. 66-68] was employed in this study. Subjects were encouraged to alter any responses to earlier cases should they change their minds while completing the instrument. As Shockley noted, this procedure helps minimize the bias due to changes in the subjects' psychological scales as they progress through the cases.

[8] The most recent authoritative discussion of the concept of materiality is in *SAS No. 47, Audit Risk and Materiality in Conducting an Audit* [AICPA, 1983]. As in past pronouncements concerning this concept, this technical standard does not provide any definitive criteria for determining what, in fact, is a material amount.

[9] The instrument was pretested on a sample of 28 audit committee members of ten NYSE firms not included in the California 500.

FIGURE 1

TREATMENT LEVELS OF INDEPENDENT VARIABLES

	Treatment Level	
	1	*2*
Subject Background	Member of Management of a Publicly Owned Firm (Managers)	Not a Member of Management of a Publicly Owned Firm (Non-managers)
Audit Firm Size Class	Big Eight	Non-Big Eight
Conflict Issue	Disclosure Dispute	Materiality Dispute
Financial Condition	Poor	Strong

RESULTS

The overall mean for the subjects' assessment of the relative likelihood that they would support the auditor was 5.33 while the means for the treatment levels of the four independent variables ranged from 4.74 to 5.92. For the individual conflict cases, the means ranged from 4.21 to 6.48. Since the midpoint of the dependent variable scale was 4.0, these results suggest that the subjects, on average, tended to support the auditors, rather than management, in the conflict scenarios.

The overall analysis of variance (ANOVA) results are presented in Table 1. Each of the four main effects was highly significant and in the predicted direction. However, one of the main effects, audit firm size class, accounted for less than one percent of the variance in the dependent variable measures.[10]

The empirical results support hypotheses 1, 3, and 4, concerning the subject background, nature of conflict issue, and financial condition factors, respectively. Corporate manager subjects were more supportive of auditors than subjects who were either retired business executives or individuals from a non-business background.[11] Additionally, the subjects were more likely to support the auditor when the focal issue was the subject of objective technical standards and when the auditee was in poor rather than strong financial condition. Even though the audit firm size factor was highly sig-

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[10] As reported in Table 1, two first-order interaction effects were significant at the .001 level, although each accounted for a fairly modest amount of the variance in the subjects' judgments. Concerning the subject background-financial condition interaction, the likelihood that the corporate manager subjects would support the auditors was increased significantly when the audited firm was in poor financial condition. The conflict issue-financial condition effect demonstrates a significant interaction between the materiality dispute and strong financial condition treatment levels. When those treatment levels were coupled, there was a significant decrease in the subjects' support for the auditors.

[11] Approximately 40 percent of each group of subjects was from NYSE firms. For each group, *t*-tests were performed to determine if there were significant differences in the responses of the subjects from NYSE and non-NYSE firms. For the corporate manager subjects, there were no significant differences at a .1 level between the mean responses of the NYSE and non-NYSE subgroups; each subgroup had higher mean responses on an equal number of data points. The results for the non-manager subjects were quite different as the mean response of the NYSE subgroup was higher than that of the non-NYSE subgroup on each of the data points. Two of these differences were significant at a .01 level while another was significant at a .05 level. The results of this test suggest that the audit committee members of NYSE firms who are not corporate managers tend to be more supportive of auditors than the same type of audit committee members of non-NYSE firms.

TABLE 1

OVERALL ANALYSIS OF VARIANCE RESULTS FOR SUBJECTS' RESPONSES TO CONFLICT CASES

	SS	*F-statistic*	*p-value*	*Variance Explained (percent)*
Main Effects				
S Subject Background	176.3	29.0	<.001	6.43
T Audit Firm Size Class	12.3	30.2	<.001	.45
C Conflict Issue	491.1	258.7	<.001	18.51
F Financial Condition	98.8	149.1	<.001	3.71
Interactions				
ST	.0	.0	>.95	.00
SC	3.8	2.0	>.16	.07
SF	49.2	74.2	<.001	1.83
TC	.3	1.4	>.23	.00
TF	.1	.5	>.48	.00
CF	24.8	54.0	<.001	.92

Note: Repeated measures ANOVA designs use the mean square associated with the specific treatment-subject interaction as the *F*-ratio denominator. The degrees of freedom for the numerator and denominator of each of the *F*-statistics reported above are one and 177, respectively. Two of the higher order interactions were significant at a .01 level but each accounted for less than .5 percent of the variance in subjects' judgments.

nificant, the modest amount of variance it explained argues against concluding that this factor significantly influences the likelihood of audit committee members supporting auditors, rather than management, in audit disputes.

LIMITATIONS

The findings and conclusions of this research are subject to several limitations. The artificial context of the experimental task limits the external validity of the results since subjects may have responded differently in a more realistic setting. The generalizability of the results also is constrained by the manner in which the independent variables were defined. Since the ANOVA design was a fixed-effects model, the empirical results may not be generalizable to the remaining treatment levels of the independent variables [Ostle and Mensing, 1975, p. 291]. In addition, subjects were asked to report the likelihood that they would support the auditor rather than management in the audit disputes. This wording may have biased the subjects' responses in the direction of supporting the auditors.

Finally, in a repeated measures design, subjects may become oversensitized to the independent variables [Greenwald, 1976; Libby, 1979; Pany and Reckers, 1980]; that is, subjects may identify the hypothesis related to one or more factors and then respond cooperatively. An effort was made to determine whether a demand effect influenced the empirical results with respect to the conflict issue factor.[12] For this purpose, a second instrument was developed identical to the original, except that it contained only the four conflict cases involving disclosure disputes. By including only the dis-

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[12] Given the amount of variance explained by the conflict issue factor, there appeared to be a higher risk that a demand effect distorted the experimental impact of that factor than that of the other within-subject factors.

TABLE 2
RESULTS OF TEST FOR EXPERIMENTAL DEMAND EFFECT

	Eight-Case Instrument	*Four-Case Instrument*
Number of Subjects	26	26
Mean Response to:		
Disclosure dispute/ Poor financial condition/ Big Eight case	6.50	6.54
Disclosure dispute/ Poor financial condition/ Non-Big Eight case	6.38	6.46
Disclosure dispute/ Strong financial condition/ Big Eight case	5.92	6.08
Disclosure dispute/ Strong financial condition/ Non-Big Eight case	5.81	5.88

Note: At a .1 level, no significant differences were found between the mean responses of the two groups.

closure dispute cases in this instrument, it was assumed that subjects would have difficulty identifying the hypothesis related to the conflict issue factor and thus be less likely to respond in an intentionally cooperative manner with that hypothesis. The four-case instrument was mailed to a random sample of 50 of the remaining "corporate manager" audit committee members compiled from the sample of California 500 firms. Twenty-six usable responses were obtained from this set of subjects. An equal number of the corporate manager subjects who completed the eight-case instrument were randomly selected for comparison purposes.

Table 2 compares the relevant data obtained from the two groups of subjects. As shown in Table 2, there were no significant differences between the mean responses to the disclosure dispute scenarios included in the four-case and eight-case instruments. If a demand effect had influenced subjects' responses to the initial instrument, a likely result of this test would have been significant differences between the mean responses to the cases shown in Table 2. The results of this limited test do not rule out the possibility of a demand effect but suggest that a demand effect, if present, did not significantly influence the findings of this study, at least with regard to the conflict issue factor.

CONCLUSIONS

The results of this study suggest that audit committee members tend to support auditors rather than management when audit disputes occur. This finding conflicts with recent charges that audit committees are reluctant to intercede on auditors' behalf in such situations. Nevertheless, the results identify certain factors that may compromise audit committee members' support for auditors.

A principal focus of the recent criticism of audit committees is that the individuals appointed to serve on them generally are disinclined to oppose important positions of management. The results of this study do not support that contention but do suggest that audit committee members who are corporate managers tend to be more supportive of auditors than members from other backgrounds. Unfortunately, the increasing time commitments required of audit committee members may be discouraging many corporate managers from accepting audit committee appointments [Mautz and Neary, 1979].

This study also identifies two contextual variables, neither of which is directly controllable by auditees, that tend to diminish the support of audit committee members for auditors involved in audit disputes. Audit committee members in this study were less likely to support the auditor when the focal issue of a dispute was not the subject of objective technical standards. More objective specification of technical standards by accounting and auditing standards setters would likely encourage audit committees to more readily support positions maintained by auditors in disputes with management.

Finally, results of the study confirm that audit committee members tend to be less supportive of the auditor when the auditee is in strong financial condition. Audit committee support for auditors may be more critical when the audited firm is in financial distress; however, lack of sufficient support when a firm is in strong financial condition also has implications for audited statements' credibility. Making audit committee members aware of their fiduciary obligations and regulatory authorities' perception of the importance of those obligations [Peat Marwick, 1983; Jenkins and Robinsen, 1985; Laventhol & Horwath, 1986] may increase support for auditors irrespective of the auditee's financial condition.

APPENDIX

ILLUSTRATIVE CASE FROM RESEARCH INSTRUMENT

Company A

—At the end of the 1984 audit in early March of 1985, a customer defaulted on a large receivable. On December 31, 1984, there was no evidence available which indicated that this customer would default. The customer's financial problems resulted from extensive damage to its production facilities caused by a fire in early January 1985. Technical accounting standards are quite explicit with regard to such a situation. The standards support the audit firm's contention that the material loss on the receivable should be disclosed in the footnotes of the 1984 financial statements. Nevertheless, management disagrees with the standards and its audit firm and asserts that since the event leading to the customer's default occurred after year-end, the loss on the receivable should not have to be disclosed in any manner.

—Financially, this company is in strong condition. The last two years have witnessed significant increases in sales, net income, and total working capital.

—This company is audited by a non-Big Eight firm.

Given the above information, how likely is it that you would support the auditors rather than management in this dispute?

Very Low Likelihood 1 2 3 4 5 6 7 Very High Likelihood

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COMMENTS

Understanding Accounting Changes in an Efficient Market—A Comment, Replication, and Re-Interpretation

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ABSTRACT: This paper presents a replication and correction of a 1978 paper concerning the security market reaction to discretionary accounting changes (a switch to LIFO). The paper contains a flaw in the experimental design. Once the design is corrected, some of the conclusions reached in the original paper must be revised. However, the corrected results do not negate the finding that the security market reaction to a LIFO adoption is conditional on earnings.

A 1978 paper by Abdel-khalik and McKeown (AM) represents one of the first attempts at incorporating earnings expectations into an explanatory model of the equity security market's reaction to the announcement of an accounting policy change. As AM point out, research in this area prior to theirs ignores the potential interaction between accounting policy changes and other variables of interest to the security markets such as earnings expectations (see, for example, Sunder [1973] or Harrison [1977]). In this regard, AM seemingly find evidence that, in fact, the adoption of LIFO does have an impact on security returns. But this effect is contingent upon the sign of the error in forecasted EPS growth. This result contributed to the subsequent widespread incorporation of earnings expectations into models of security market reactions to accounting policy changes in general and into models of the LIFO-switch decision in particular (e.g., Biddle and Lindahl [1982]; Ricks [1982]).

The purpose of this study is threefold. First, we show that the analysis of variance (ANOVA) test design employed by AM is fundamentally flawed in that it can yield a statistically significant interaction term when, in fact, only main

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effects are present. Second, to confirm that AM did employ a flawed design we exactly replicate the AM study. In this regard we are also performing an "audit" of the AM results in the sense suggested by Kane [1984]. Third, we correct the flaw in the AM design and again replicate their study yielding different results in several instances. This represents an "improvisational replication" in the terminology of Kane in that, by correcting the flawed design, we improve upon the original paper.

THE AM TEST DESIGN AND RESULTS

AM state [p. 859] that they are employing a three-factor, fully crossed, matched-pairs ANOVA design to investigate the impact of the adoption of LIFO inventory costing on a firm's security market return.[1] The three factors as defined by AM are:

A: the firm's decision to switch to LIFO,

SF: the sign of the forecasted change in earnings per share (EPS) for the switch firms, and

CF: the sign of the forecasted change in EPS for the control firms (matched non-switch firms).

AM report highly significant results for the $A \times SF$ and $SF \times CF$ effects from this ANOVA [p. 860]. None of the three main effects would be significant at even very high type I error levels. The $A \times CF \times SF$ effect appears to be marginally significant. These results are interpreted as supporting the position that the LIFO-switch decision does convey information to an efficient market, but that the market's interpretation of this information depends on the sign of the earnings forecast error.

Such a conclusion is appealing. Unfortunately, it is inappropriate to base such a conclusion on AM's ANOVA results as they presently stand.[2] This is because AM, in defining the main effects *SF* and *CF* in the manner specified above, have rendered them uninterpretable as main effects in the ANOVA design. In particular, these two effects are each conditional on the *A* effect. For a switch firm, *SF* represents the sign of its own forecasted EPS change. But, for a non-switch firm, the meaning of *SF* changes to represent the sign of the forecasted EPS change for a matched switch firm. Similarly, *CF* represents the sign of the firm's forecasted EPS change for a non-switch firm, but for a switch firm it changes meaning and represents the sign of the forecasted EPS change for a matched non-switch firm. This interpretation of the way in which AM defined the *SF* and *CF* factors is further supported by AM's Figure 2. Figure 2 states that there are 12 control and 12 switch firms for which factor *SF* is positive and factor *CF* is negative, and that there are another 21 control and 21 switch firms for which factor *SF* is negative and factor *CF* is positive. The fact that the number of control and switch firms is identical for these factor combinations implies that each matched pair takes on identical values for the *SF* and

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[1] A question arises as to why an ANOVA is employed by AM at all. The forecasted EPS changes are continuous variables and a potentially more powerful approach would incorporate their magnitude, in addition to their sign in explaining unexpected returns. However, since it is unclear what the exact form of the relation is between forecasted EPS changes and unexpected returns, a conservative approach to the problem is to treat the EPS change as a discrete variable and perform an ANOVA.

[2] In addition to performing an ANOVA, AM also graph the group means over the same time period (months −3 to +3 relative to the LIFO switch date). The group means are defined differently for the graph in Figures 3 and 4 (e.g., CAR C/S+ is the mean of the control firms for which the matched switch firm has a positive forecasted EPS change). Further analysis of the data, not presented here, indicates that the figures used in these graphs are consistent with the definitions given for them.

TABLE 1

HYPOTHETICAL THREE-FACTOR DATA ARRAY WITH THREE-WAY ANOVA RESULTS
FACTOR SCORES
(0=Level 1, and 1=Level 2)

Dependent Variable	*Factors* *X*	*Y*	*Z*
1	1	1	1
1	1	1	0
1	1	1	1
1	1	1	0
0	1	0	1
0	1	0	0
0	1	0	1
0	1	0	0
1	0	1	1
1	0	1	0
1	0	1	1
1	0	1	0
0	0	0	1
0	0	0	0
0	0	0	1
0	0	0	0

Mean Square Error=0
Sum of Squares, $X, Z, X*Y, X*Z, Y*Z, X*Y*Z*=0$
Sum of Squares, $Y=4$

CF factors. This is consistent with the AM specification of the factors and supports further the inference that both factors are uninterpretable as main effects in the context of the AM design.

The impact of AM's choice of factor definitions for *SF* and *CF* on their results is not immediately obvious. To gain insight into just what the effect is, we constructed the hypothetical three-factor data array presented in Table 1. Factor *Y* explains 100 percent of the variance in the accompanying three-way ANOVA design since it always equals the dependent variable. In the context of AM, *Y* would represent the sign of the switch firm's forecasted EPS change, which is expected to have a significant positive correlation with unexpected returns (the dependent variable).[3] Table 2 demonstrates what happens when we identify the factors in the manner of AM. Note that the explanatory power of *Y* is now spread over main effect *Z* and cross effect $X*Y$ and $X*Z$ in addition to *Y*. Thus, AM's choice of definition for *SF* and *CF* not only renders them uninterpretable as main factors, but can also lead to significant false interaction between *A* and *SF* and/or *A* and *CF*!

REPLICATION OF THE AM ANOVA

An exact replication of AM is performed for two reasons. First, since our primary criticism of the AM design rests on how the *SF* and *CF* are defined, a replication will further substantiate our interpretation of how AM defined *SF* and *CF* in their study. Such a replication

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[3] It was the lack of significance of the forecasted EPS change that caused us to question AM's results in the first place. It was an example such as this one that gave us the insight into just how AM's ANOVA factors were defined.

TABLE 2
HYPOTHETICAL THREE-WAY ANOVA WITH AM FACTOR DEFINITIONS
FACTOR SCORES
(0=Level 1, and 1=Level 2)

Dependent Variable	*Factors*		
	X	*Y*	*Z*
1	1	1	1
1	1	1	0
1	1	1	1
1	1	1	0
0	1	0	1
0	1	0	0
0	1	0	1
0	1	0	0
1	0	1	1
1	0	0	1
1	0	1	1
1	0	0	1
0	0	1	0
0	0	0	0
0	0	1	0
0	0	0	0

Mean Square Error=0
Sum of Squares, $X=Y*Z=X*Y*Z=0$
Sum of Squares, $Y=Z=X*Y=X*Z=1$ (25 percent)

also can be viewed as an "audit" of the AM results, since as Kane [1984] states: "successful and independent repetition of an econometric experiment increases professional confidence in the experiment's alleged results." Inspection of the AM results reveals that the implied mean sum of squares (MSS) for the ANOVAs for effects *SF*, *CF*, and $SF \times CF$ differs from the implied MSS for the remaining effects. One can always use the reported *F*-statistics and reported mean sums of squares (MSS) to compute the MSS for the error term (ESS) in any ANOVA. An ANOVA, of course, has only one ESS. This calculation shows that two *different* ESS terms are involved in Table 3 for any given month.

The *F*-statistics for the main *A* effect, the $A \times SF$ and $A \times CF$ two-way interactions, and the $A \times SF \times CF$ three-way interaction were calculated using an ESS of approximately .078 (for month -1). The *SF* and *CF* main effects, and the $SF \times CF$ two-way interaction reported in Table 3 (again for month -1) show *F*-statistics computed based on an ESS of approximately .133. Similar findings hold for all months reported in Table 3. This indicates that the data in Table 3 are not the results of one three-factor, completely crossed ANOVA. Rather, the Table appears to reflect partial results from two separate ANOVAs. The *A*, $A \times SF$, $A \times CF$, and $A \times SF \times CF$ results may have been generated by one three-factor ANOVA. Main effects for factors *SF* and *CF* and for the two-way interaction $SF \times CF$ do not appear to be from the same three-factor ANOVA and may be from a separate two-factor ANOVA. Similarly, AM report that their design yields an *F* with one and 103 degrees of

TABLE 3
MIXED FULL (INCORRECT) ANOVA
(AM DESIGN AS REPORTED)

		A	SF	CF	$A \times SF$	$A \times CF$	$SF \times CF$	$A \times CF \times SF$
	Mean Sum of Squares	.00640	.13685	.02685	1.81852	.00295	.68242	.12593
−3	F-Statistic	.06	1.25	.25	18.06	.03	6.23	1.25
	Prob. of Significance	.8012	.2648	.6209	.0001	.08642	.0133	.2648
	Mean Sum of Squares	.01006	.13170	.03784	2.46034	.00269	.54970	.27911
−2	F-Statistic	.10	1.17	.34	24.30	.03	4.87	2.76
	Prob. of Significance	.7529	.2812	.5632	.0001	.8707	.0284	.0984
	Mean Sum of Squares	.00164	.06220	.02241	2.74267	.00083	.87524	.29982
−1	F-Statistic	.02	.51	.18	25.37	.01	7.17	2.77
	Prob. of Significance	.9020	.4762	.6688	.0001	.9301	.0080	.0974
	Mean Sum of Squares	.01095	.08614	.00043	2.8081	0.00005	1.37670	.39318
0	F-Statistic	.09	.66	0.0	24.02	0.00	10.51	3.36
	Prob. of Significance	.7599	.4184	.9544	.0001	.9827	.0014	.0681
	Mean Sum of Squares	.02661	.13381	.01336	1.9344	.01125	1.00284	.15722
+1	F-Statistic	.23	1.09	.11	17.02	.10	8.19	1.38
	Prob. of Significance	.6290	.2971	.7415	.0001	.7534	.0046	.2409
	Mean Sum of Squares	.07555	.06312	.01514	2.36942	.02905	1.11589	.28686
+2	F-Statistic	.60	.46	.11	18.87	.23	8.21	2.28
	Prob. of Significance	.4388	.4963	.7389	.0001	.6310	.0046	.1322
	Mean Sum of Squares	.12893	.08970	.01046	1.82991	.11567	1.37260	.21198
+3	F-Statistic	1.04	.68	.08	14.76	.93	10.38	1.71
	Prob. of Significance	.3090	.4111	.7788	.0002	.3352	.0015	.1925

A, $A \times SF$, $A \times CF$, $A \times CF \times SF$ from full design (three-way)
SF, CF, $SF \times CF$ from reduced design (two-way)

freedom for the numerator and denominator, respectively. However, since the total sample size is 214 firms, there should be 206 degrees of freedom associated with the F's denominator. Thus, the actual design used by AM is not the design reported.

Using the set of firms specified in the Appendix of AM and a listing of LIFO switch dates for the sample of firms supplied by the authors, we were able to closely replicate the results. One pair of firms was lost due to our inability to locate the matched control firm on the CRSP tapes. This replication, presented as Table 3, corresponds quite closely to AM's Table 3. These results are based on *two* ANOVAs. Effects A, $A \times SF$, $A \times CF$, and $A \times CF \times SF$ are from a fully-crossed three-way design where factors CF and SF are defined as suggested in the preceding section. Effects SF, CF, and $SF \times CF$ are reported from a two-way design where factors CF and SF are again defined as suggested in the preceding section. There is, however, no substantive difference between these two-way results and the three-way results for factors CF, SF, and $SF \times CF$ that are suppressed by AM. The degrees of freedom for the F-statistic from the three-way (two-way) ANOVA are one and 204 (one and 208) for the numerator and denominator respectively. Given the close correspondence of significance levels between these results and the AM

TABLE 4

CORRECTED FACTORIAL DESIGN AND NUMBER OF OBSERVATIONS PER CELL

Factor SF	*Factor* CF	*Factor* A *Switch*	 *Control*
+	+	64	64
+	−	12	21
−	+	21	12
−	−	10	10

Table 3 results, it appears that the AM must have used degrees of freedom one and 206 (one and 210 for the two-way design) in their study, contrary to what is stated.

AM RE-INTERPRETED

Due to the flawed test design employed, the AM results as they presently stand are uninterpretable. However, the flaws in the design are easily corrected. We accomplish this correction by redefining *SF* as the sign of the firm's own earnings forecast error and *CF* as the sign of a matched firm's earnings forecast error. This design is described in Table 4, which replicates AM's Figure 2 discussed earlier. A modified replication using a two-way ANOVA with *A* and *SF* as the main effects was also performed.[4] The results from this modified two-way ANOVA do not differ substantively from those reported for the full three-way design and therefore are not reported here. The results for our rectified, fully-crossed, three-way ANOVA design are presented in Table 5. The most striking difference in these results from those of the AM replication is the high degree of significance of the *SF* effect. This is not unexpected since a wealth of empirical documentation supports the contention that the firm's own earnings forecast error is positively correlated with unexpected returns. In fact, the lack of such a result in the AM paper represented something of an empirical anomaly prior to this correction and replication.

The results of Table 5 also differ from the AM replication results with respect to effects $A \times SF$ and $A \times CF$. The $A \times SF$ effect, while still statistically significant, is of considerably less magnitude when the *SF* and *CF* factors are properly defined. Alternatively, the $A \times CF$ effect, which is insignificant in the AM replication (and in AM) is statistically significant in the corrected design. This may represent evidence for some form of industry earnings effect (since industry was the primary matching variable) as well as for a firm earnings effect contributing to the market's reaction to the firm's LIFO switch decision. Attempts to explain these results are beyond the scope of this comment, which is limited to the data analysis as originally presented in AM. It does appear that the effect of the original AM design was to heighten the $A \times SF$ effect

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[4] The inclusion of the sign of the matched firm's earnings forecast error in the ANOVA by AM is apparently arbitrary. We include it to remain within the spirit that this research is a comment/re-interpretation of AM's original work.

TABLE 5
FULL *Correct* ANOVA

		A	SF	CF	$A \times SF$	$A \times CF$	$SF \times CF$	$A \times CF \times SF$
	Mean Sum of Squares	.00640	.83885	.14311	.64717	.35807	.68557	.12593
−3	*F*-Statistic	.06	8.33	1.42	6.43	3.56	6.81	1.25
	Prob. of Significance	.8012	.0043	.2346	.0120	.0608	.0097	.2648
	Mean Sum of Squares	.01006	1.07954	.22818	.79993	.52708	.55259	.27911
−2	*F*-Statistic	.10	10.66	2.25	7.90	5.21	5.46	2.76
	Prob. of Significance	.7529	.0013	.1348	.0054	.0235	.0205	.0984
	Mean Sum of Squares	.00164	1.03117	.37423	.79629	.62829	.87958	.29982
−1	*F*-Statistic	.02	9.54	3.46	7.36	5.81	8.13	2.77
	Prob. of Significance	.9020	.0023	.0643	.0072	.0168	.0048	.0974
	Mean Sum of Squares	.01095	.98719	.45530	.95638	.49730	1.3821	.3932
0	*F*-Statistic	.09	8.44	3.89	8.18	4.25	11.82	3.36
	Prob. of Significance	.7599	.0041	.0498	.0047	.0404	.0007	.0681
	Mean Sum of Squares	.02661	.78306	.15987	.76311	.38855	1.0065	.15722
+1	*F*-Statistic	.23	6.89	1.41	6.71	3.42	8.86	1.38
	Prob. of Significance	.6290	.0093	.2370	.0103	.0659	.0033	.2409
	Mean Sum of Squares	.07555	.76271	.24554	.84451	.62530	1.1196	.28686
+2	*F*-Statistic	.60	6.07	1.96	6.73	4.98	8.92	2.28
	Prob. of Significance	.4388	.0145	.1635	.0102	.0267	.0032	.1322
	Mean Sum of Squares	.12893	.50259	.09224	.89309	.55922	1.3766	.21198
+3	*F*-Statistic	1.04	4.05	.74	7.20	4.51	11.10	1.71
	Prob. of Significance	.3090	.0454	.3894	.0079	.0349	.0010	.1925

at the expense of the *SF* and $A \times CF$ effects, since the overall explained variance is the same for the full correct ANOVA in Table 5 and the full incorrect ANOVA which is partially reported in Table 3.

CONCLUSION

In this paper we point out a major flaw in the test design employed by Abdel-khalik and McKeown in their 1978 study of LIFO switches. We replicate the AM tests, confirming that the flawed design was actually employed and providing a successful audit of these flawed results. Finally we correct the design and obtain results that differ from those obtained by AM in several instances. However, AM's finding that the market's reaction to the LIFO switch decision is conditional on the sign of the earnings forecast error is still supported, although the magnitude of its effect is diminished relative to that reported by AM.

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Understanding Accounting Changes in an Efficient Market: Analysis of Variance Issues

James C. McKeown

In their comment on Abdel-khalik and McKeown [1978] (AM), Cready and Shank (CS) make three basic claims:

1. AM chose an incorrect statistical method;
2. AM incorrectly applied the statistical method they chose; and
3. CS have a correct statistical method.

This reply will demonstrate that the claims above are false.

In analyzing the comment, it appears that CS do not understand the nature and properties of ANOVA designs that use a blocking factor combined with one or more crossed factors. The evidence of this conclusion pervades the comment, but is probably most clearly shown on page 592 where CS state: "An ANOVA, of course, has only one ESS." (Their previous sentence defined ESS to be "the error term" in an ANOVA.[1]) An examination of a standard statistics book would have revealed this statement to be inaccurate. Any ANOVA design that has a blocking factor combined with one or more crossed factors will necessarily have more than one error term (ESS in CS's usage).[2] Specifically one error term (*excluding* the between-block sum of squares) will be used for analysis of any effect that includes the blocking factor while a second error term (*including* the between-block sum of squares) will be needed for analyzing effects that do not include the blocking factor. Even though CS correctly deduced AM used a design with more than one error term, CS were unable to figure out *why* AM's design required the use of more than one ESS, and therefore CS incorrectly made claim 2 above. This "fundamental flaw" in the thinking of CS underlies their entire paper.

Another demonstration that CS do not understand matched-pair (blocking) ANOVA designs occurs on page 590: "A&M state [p. 859] that they are em-

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[1] "Error term" is actually ambiguous in an ANOVA context. However, by context CS define error term to be the denominator of an F-ratio. Therefore, the current paper assumes CS's usage of either "error term" or "ESS" to be equivalent to "denominator of an F-ratio."

[2] For discussion and examples of this type of ANOVA with more than one error term used, see Keppel [1982, pp. 408–418], Myers [1972, pp. 191–211], or Winer [1971, pp. 514–539].

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ploying a three-factor, fully crossed, matched pairs ANOVA design. . . ." In fact, AM page 859 states: ". . . a three-factor analysis of variance (ANOVA) was utilized." The critical difference is CS's addition of the phrase "fully crossed" which is contradictory to the phrase "matched pairs." A fully-crossed design assumes each observation is independent of each other observation. Clearly, that assumption is invalid when two observations are included from each *matched* pair. Thus AM (correctly) did not use a fully-crossed design. Unfortunately, CS chose a fully-crossed design as their proposed "better" alternative to the original AM design. For the reasons stated above, the fully-crossed design proposed by CS is invalid. Thus, their claim 3 above (that they provide a correct statistical method) is false.[3]

One obvious question, though, is whether the CS design could be corrected by converting their switch factor to a blocking factor. This simple fix yields an invalid design because it will result in placement of observations of some pairs into non-corresponding cells of the design. When a blocking factor is used, the observations from a given block must be placed in cells whose factor levels differ *only* for the blocking factor. (The levels for all other factors must be the same for the given pair of observations.) This requirement would be violated in CS's proposed design (modified to recognize the pair matching) because a pair of firms that had different signs of their forecasted earnings change would have different levels of factors *CF* and *SF* (invalid) in addition to the different level of factor *A* (appropriate). For example, consider a pair that had a negative forecasted change for the switch firm and a positive forecasted change for the control firm. Under the modified *CS* design, the switch firm would have levels 2,1,2 (Switch, −, +) while the matched control firm would have levels 1,2,1 (Control, +, −). This design cannot be computed. Thus, even a modification of CS's proposed design is invalid and cannot be used.

Given that the CS-proposed design cannot be used (in its original or modified form), CS's claim that the original AM design was incorrect should be considered. The AM design has three factors.[4] Factor *A* identifies the decision of the sample firm to switch to LIFO or remain on FIFO. Factor *SF* represents the sign of the forecasted change in earnings for the switch firm in the matched pair that includes the subject firm. That is, *SF* is the sign of the subject firm if the subject firm is a switch firm, or *SF* is the sign of the matched switch firm if the subject firm is a control firm. Similarly, factor *CF* is the sign of the forecasted change in earnings for the control firm in the matched pair that includes the subject firm.

Examining the statistical validity of the AM design as described above, it does recognize the dependence between the observations from a given pair of firms. In addition, the AM design assigns factor levels that differ only on the blocking factor (*A*) for these observations. The levels of factors *SF* and *CF* will be the same for the observations from the given pair. For the example discussed above, the switch firm would have levels 2,1,2 (Switch, *SF*−, *CF*+)

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[3] As discussed later in the paper, there are several other flaws in the CS design.

[4] The notation in the original AM paper is used consistently here. CS create a slight confusion in notation by using *SF* to mean the sign of the forecasted change in switch firm earnings when discussing the AM design, but using *SF* to mean "the sign of the firm's own earnings forecast error" (p. 594) when they discuss their own design. The current paper uses *SF* consistently to mean the sign of the forecasted change in switch firm earnings (and similarly for *CF*).

while the control firm would have levels 1,1,2 (Control, *SF*−, *CF*+). Thus, the factor levels for these firms differ only on the blocking factor (factor *A*) and have the same levels for factors *SF* and *CF*. This design is statistically valid in that the dependency between observations from the matched pairs is recognized and the design can be computed. The only remaining issue is whether the AM design is appropriate for the research question being addressed.

AM states [p. 851] that the objective in the study is to examine the joint effect of accounting changes to LIFO with other variables on the behavior of market returns on common stocks. This objective is implemented by testing H_{o2} in AM. In addition, AM also tests (by testing H_{o1}) whether the switch to LIFO had an effect on market returns.

An examination of the AM ANOVA design, which includes a blocking factor, must start with an understanding of the effect of the blocking factor on the dependent variable (the cumulative abnormal return, or CAR). The design includes a separate mean for each block. The effective value of each observation's CAR is thus transformed into the deviation of the original CAR from the mean CAR of the two firms (control and switch) in the pair of firms. The ANOVA then estimates the main effect of switch vs. control (factor A) as the difference between the CAR deviations from the pair means. This estimate is modified by the other main effects and their interactions to allow for the possible effect of signs of the forecasted change in earnings. A test of this main effect then constitutes a test of the market effect of the decision to switch to LIFO. AM report this effect as not significant. This result is consistent with the previous LIFO studies.

The main effect of factor *SF* estimates the difference in CARs between the matched pairs with switch firms that had positive forecasted changes in earnings (*SF*+) and the matched pairs with switch firms that had negative forecasted changes in earnings (*SF*−). Note that this main effect does not test (nor was it intended to test) whether the sign of forecasted earnings of switch firms affected CAR. This main effect is included in the AM design solely to make sure any result of the test of H_{o2} (the main research question) is not contaminated by the normal relationship that firms with positive forecasted changes in earnings will experience positive CARs. The main effect of factor *CF* has an exactly analogous role in the AM design. It is included strictly to control for normal effect of the sign of forecasted control firm earnings changes on observed CARs.

These two main effects and the interaction term between them (*SF*×CF) are in the design to complete the control for exactly the effect that concerns CS: the normal association between signs of forecasted earnings changes and CARs. Any differences in CARs related specifically to differences in the sign of the change in forecasted earnings for the switch member of a pair will be picked up by *SF*. Any differences in CARs related specifically to differences in the sign of the change in forecasted earnings for the control member of a pair will be picked up by *CF*. Any differences caused by the members of pairs having opposite signs for their forecasted earnings changes will be picked up by *SF*×*CF*.[5]

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[5] Note that the effect of the different signs of forecasted earnings change for the members of a pair (measured as *SF*×*CF*) would be expected to be the largest of the three pure control effects discussed in this paragraph (*SF*, *CF*, and *SF*×*CF*). Consistent with this notion, the *SF*×*CF* interaction effect *is* significant at the five percent alpha level (as reported in Table 3 in AM). While not necessary for the analysis, this significance is

The interactions involving factor A (switch vs. control) will all be measured in terms of deviations of the individual firm CARs from the average CAR for the matched pair. Therefore, the interaction $A \times SF$ tests whether the difference in the CARs of the matched pairs is related to the sign of the forecasted change in earnings of the switch firm of the pair. This is a direct answer to the research question posed in AM and a direct test of H_{02} in AM. Rejection of this null hypothesis means specifically that the difference between the CARs of paired firms *does* depend on the sign of the forecasted change in the switch firms' earnings. Since the controls discussed in the previous paragraph have already filtered out the effect on CARs caused purely by sign of forecasted change in firms' earnings, the test of the interaction $A \times SF$ is an unambiguous test of the research question and null hypothesis of AM.[6] Thus CS's first claim is incorrect.

CONCLUSION

Cready and Shank made three basic claims: (1) AM chose an incorrect statistical method; (2) AM incorrectly applied the statistical method they chose; and (3) CS have a correct statistical method. This paper has shown that all three of these claims are false.

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consistent with expectations concerning the design.

Note also that all three of these effects (SF, CF, and $SF \times CF$) have larger error terms than the other effects measured in this design. Since these three effects do not involve the blocking factor, their error terms include the between-blocks sum of squares. This higher error term makes the tests of these effects less powerful in general than tests of effects which involve the blocking factor (A).

[6] One further point concerning the CS design needs to be made. Even if the design could be implemented, it still would be a considerably inferior design. The CS design uses the sign of the subject firm as the basis for the second factor (call it OF for own forecast) regardless of whether it is a switch or control firm. Then the sign of the firm matched to the subject firm is the basis for the third factor (call it MF for matched forecast). The net result is that the levels of factor OF are based on the signs of the forecasted earnings changes of switch firms for half of the firms (the switch firms) and the levels of factor MF are based on the signs of the forecasted earnings changes of switch firms for half the firms (the control firms).

CS have managed to totally confound the measurement of the effect of switch firm forecasts by using those forecasts to set levels of one factor for half of the observations and set levels of a different factor for the other half of the observations. The expected result of such a confounding would be a spreading of the proper effect across the confounded factors. This is exactly what CS report when they find their $A \times OF$ less significant than AM's $A \times SF$ and $A \times MF$ more significant than AM's $A \times CF$. That is, since they have spread the proper $A \times SF$ effect across two confounded factors (OF and MF), we would expect to observe the $A \times SF$ effect partly on $A \times OF$ and partly on $A \times MF$.

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FINANCIAL REPORTING

M. Edgar Barrett, Editor

Establishing the Common Stock Equivalence of Convertible Bonds

Bruce R. Gaumnitz and Joel E. Thompson

ABSTRACT: The identification of common stock equivalents is necessary to compute primary earnings per share. However, the APB/FASB rules for classifying convertible securities as common stock equivalents lack a well-defined rationale. This paper describes a periodic market-based statistical test to establish common stock equivalence for convertible bonds. The test is consistent with the APB's stated intent and is based on the theoretical valuation of convertible bonds. It is compared with the classification rules of the APB/FASB for common stock equivalents using a randomly selected sample of convertible bonds. There is little agreement between the convertible bonds classified as common stock equivalents by the APB/FASB rules and those so classified by the market-based test described herein.

ACCOUNTING Principles Board (APB) Opinion No. 15 [AICPA, 1969] requires that common stock equivalents be considered in primary earnings per share calculations. However, the various two-thirds rules of the APB and Financial Accounting Standards Board (FASB) for determining the common stock equivalence of convertible securities lack a well-defined rationale and are largely arbitrary. The rules do not even tie in explicitly with the specified characteristics of common stock equivalents given by the APB.

This paper suggests an alternative criterion for determining the common stock equivalence of convertible bonds, the most common convertible security. The alternative criterion differs from those of the APB and FASB in two major ways. First, the method suggested determines common stock equivalents periodically. The APB/FASB rules

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require that the determination be made only at the time of issuance of the convertible bond. As other authors have suggested (e.g., Givoly and Palmon [1981]; Sterner [1983]; and Bierman [1986]), since economic conditions change over time and the importance of the conversion feature can change with economic conditions, a periodic determination is more flexible and less likely to misrepresent the current relevance of the conversion feature.

Second, the proposed method uses a market test to classify convertible bonds as common stock equivalents. The rationale behind the test is the belief that a convertible bond is substantially equivalent to common stock when it is priced in the market as though it were common stock. This test is based on the theoretical valuation of convertible bonds.

The APB/FASB classification rules for common stock equivalents are compared with the suggested market test for a randomly selected sample of convertible bonds. There is little agreement between the convertible bonds classified as common stock equivalents by the APB/FASB rules and the market test. In the 17 cases in which the market test that we used identified convertible bonds as currently equivalent to common stock, only two were classified as common stock equivalents by the APB/FASB rules.

The next section examines the APB's description of common stock equivalents and the APB's and the FASB's classification rules. Section three reviews the theoretical valuation of convertible bonds and describes the substantial equivalence of convertible bonds and common stock. The market test is described in the fourth section, followed by empirical results, two case studies, and a discussion of alternative classification methods. A summary and concluding remarks are provided in the final section.

COMMON STOCK EQUIVALENTS ACCORDING TO THE APB

The APB describes the nature of common stock equivalents in APB Opinion No. 15 [AICPA, 1969, paragraph 25]. A common stock equivalent typically allows its holders to become common stockholders at their option. Like common stockholders, holders of common stock equivalents "can expect to participate in the appreciation of the value of the common stock. . . ." Moreover, the value of common stock equivalents should "tend to reflect changes in the value of the common stock."[1]

While these characteristics may give an intuitive understanding of a common stock equivalent, they do not readily translate into an obvious classification procedure. Hence, the APB developed a largely arbitrary rule for identifying common stock equivalents. For convertible securities, the original rule in APB Opinion No. 15 stated that a common stock equivalent had a cash yield when issued of less than two-thirds of the then current bank prime interest rate [AICPA, 1969, paragraph 33]. This rule was subsequently modified by the FASB. The average yield on Aa corporate bonds was substituted for the bank prime rate [FASB, 1982] and the lowest effective yield was substituted for the cash yield [FASB, 1985].

All of these rules fail to tie in explicitly with the characteristics of common stock equivalents quoted above from APB Opinion 15. In particular, (1) a yield test of any form does not follow directly from the characteristics of a common stock equivalent specified by the APB, and (2) the two-thirds fraction that is used appears to be largely arbitrary. Though expedient, this approach is neither closely related to the properties that characterize common stock equivalents as defined by the APB/FASB nor is it theoretically based (see Frank and Weygandt [1970] and Hofstedt and West [1971] for additional discussion of these points).

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[1] The APB also states [AICPA, 1969, paragraph 25] that a common stock equivalent ". . . because of its terms and circumstances under which it was issued, is in substance equivalent to a common stock," and that "Neither conversion nor the imminence of conversion is necessary to cause a security to be a common stock equivalent." Neither of these characteristics appear to help describe the essential nature of a common stock equivalent.

In contrast, the proposed market test builds directly on these defining characteristics of common stock equivalents and has a theoretical basis in the finance literature. Given that paragraph 25 of APB Opinion 15 provides that holders of common stock equivalents "can expect to participate in the appreciation of the value of the common stock . . ." and that the value of common stock equivalents should "tend to reflect changes in the value of the common stock," it is logical to identify common stock equivalents using comparative market price movements rather than using cash or effective yields. In other words, since the value of a common stock equivalent depends upon the value of the common stock, the values of the two securities should tend to move together. This market relation forms the basis for the proposed test examined for convertible bonds in the next section.[2]

THE THEORETICAL VALUATION OF CONVERTIBLE BONDS

In this section the theoretical valuation of convertible bonds is reviewed. Based on this review, an explicit classification for common stock equivalents is suggested. The classification is empirically applied in the next section and compared to that of the APB/FASB rules.

The theoretical valuation of convertible bonds is depicted in Figure 1, adapted from similar figures in Brennan and Schwartz [1977] and Ingersoll [1977a].[3] The vertical axis represents dollars while the horizontal axis represents the market price of common stock. The exercise price is the implicit price of common stock based on the issue price of the convertible bond. The curved continuous line represents the market value of a convertible bond, the curved broken line represents the market value of the straight bond inherent in the convertible bond, and the broken horizontal line represents the price of a risk-free bond.

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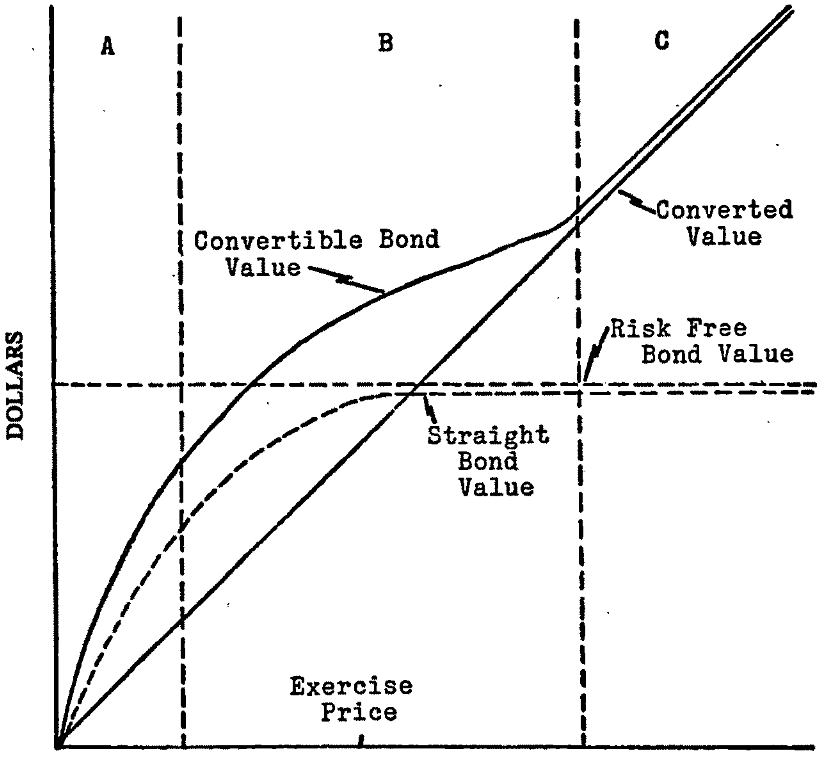
[2] There is little comfort in the argument that all dilutive securities are taken into account when computing fully diluted earnings per share. The logical extension of this argument is simply to omit primary earnings per share altogether.

[3] These papers extend the theory of option and warrant pricing [Black and Scholes, 1973; Merton, 1973] to convertible bonds. Brennan and Schwartz's [1977] development uses a specified stochastic process for the value of the firm and certain boundary conditions (e.g., the market value of the convertible bond cannot be less than its converted value) to derive the valuation of a convertible bond. Since they use numerical methods to derive their solution, they are able to incorporate discrete coupon and dividend payments, conversion rights exercisable at any time, call options, and the possibility of bankruptcy into their model. Their assumptions include that convertible bondholders pursue an optimal conversion strategy, convertible bond issuers pursue an optimal call strategy, the market value of the firm's securities is determined exogenously (and follows the specified stochastic process over time), and the riskless rate of interest is known and constant. Ingersoll [1977a], using a similar framework, focuses on closed-form solutions (instead of employing numerical methods) in certain special cases. The results seem consistent with empirical evidence presented elsewhere (e.g., Brigham [1966]; Jennings [1974]) with the exception of the apparently suboptimal call policies employed in practice (see Ingersoll [1977b] for a discussion). Figure 1 is drawn assuming no call provision (as well as a constant conversion ratio). Of course, if there is a call provision and the market price of the common stock is in excess of the "optimal" call price of the common stock, the value of the convertible bond will not differ much from its converted value, the value to the investor in the event of a call (which will exceed the redemption price of the bond in this region). Also, Figure 1 uses the market value of a share of common stock on the horizontal axis (as done by Van Horne [1983]) instead of firm value. Thus, the convertible bond valuation curve may have a non-zero intercept.

Figure 1
Price Behavior of a Hypothetical Convertible Bond



COMMON STOCK PRICE

The solid diagonal line represents the market value of the common stock which could be obtained by converting the debt into common stock. Finally, the two broken vertical lines divide the graph into three regions that will be discussed in turn.

In region A, the convertible bond trades primarily as a straight bond. Although a modest premium exists over the straight bond value, at stock prices well below the exercise price the additional value created by the presence of the conversion feature is small. In this region, the convertible bond is substantially equivalent to a straight bond and is not a common stock equivalent.

Region B is a transition region. Here, the security trades neither like a straight bond nor like a common stock. When common stock prices are close to the exercise price, convertibles offer much of the upside potential of the underlying common stock while the risk of loss is buffered by the security's value as a bond. In this region, the convertible bond behaves as a true hybrid security, exhibiting price behavior that differs significantly from that of both the common stock and straight bond. It is neither a common stock nor a straight bond equivalent.

In region C the convertible trades near the converted value line (i.e., market participants essentially value it as though it were a common stock). The loss protection provided by the bond provisions of the security is now greatly reduced, resulting in only a small premium over converted value.[4] In this region, and only in this region, the convertible bond is priced similarly to common stock in the market place. Thus, it is only in this region that the convertible bond should be considered a common stock equivalent as defined by the APB.[5]

Note, however, that there is no assurance that the APB's and the FASB's rules will be likely to identify convertible bonds trading in region C as common stock equivalents. Their rules are applied only at the time of issuance and relate only indirectly (through yield computations) to market prices. However, the market test described in the next section is likely to identify convertible bonds that are trading in region C.

A MARKET TEST

The essence of the justification for the market test is that convertible bonds trading near the converted value line are priced similarly to common stock and should be so classified according to the stated intent of the APB/FASB rulings. For any particular bond, the equation of the converted value line is known—it is the line passing through the origin with a slope equal to the number of shares of common stock obtainable upon conversion of the bond (i.e., the conversion ratio). Ordinary least squares may be used to regress the market price of the convertible bond on the price of the common stock. Statistical tests may then be used to evaluate the hypothesis that the fitted line and the converted value line are essentially the same. If they are, a common stock equivalent has been identified.[6]

Nonlinearity of the data, which is expected in portions of regions A and B, creates potential problems since a simple linear regression model will be misspecified.[7] These problems can be overcome by using polynomial regression models and model selection procedures, if desired, but will not be of great consequence unless there is pronounced curvature in the data for the range of stock prices observed. The effect of these refinements on the classification process is discussed and illustrated in the next section of the paper.

Ignoring these considerations, the simple linear model to be fitted is

$$Y_t = \beta_0 + \beta_1 X_t + \epsilon_t \qquad (1)$$

where: Y_t is the market price of the convertible bond at time t; X_t is the market price of a share of common stock at time t; β_o and β_1 are the regression coefficients; and ϵ_t is the error term with the usual assumptions of independence, normality, zero mean, and constant variance.

If the convertible bond is trading in region C of Figure 1, then β_0 should be zero or slightly larger and β_1 should equal the conversion ratio or be slightly smaller. The departures from zero and the conversion ratio are due to such factors as risk, and differentials between interest and dividend payments. Because these departures are not known or easily determined, the null hypothesis employed here is that a convertible bond is a common stock equivalent when β_0 is zero and β_1 equals the conversion ratio.

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[4] There are other reasons for premiums such as differentials in interest and dividend payments, differentials in transaction costs, and restrictions prohibiting the holding of common stock by certain institutional investors [Brigham, 1966; Jennings, 1974]. In region C, the conversion privilege (option value) is primarily responsible for the market price of the convertible bond.

[5] The equation of the convertible bond value line in region C is not identical to the converted value line. Instead, it should asymptotically approach the converted value line from above. Since the proposed market test involves testing whether these two lines coincide, it is an approximation.

[6] One characteristic of this approach is that convertible bonds issued at substantial premiums over their converted values will tend not to be classified as common stock equivalents immediately. Reclassification can take place if the common stock price rises. The Celanese case study provided below illustrates a classification change.

[7] Both the estimated coefficients and standard errors may be biased [Maddala, 1977, pp. 155-156].

Either an *F*-test or the Bonferroni method can be used to test this joint null hypothesis [Neter and Wasserman, 1974, pp. 140–149]. The *F*-test is normally used since it takes into account the covariance between the estimated intercept and slope coefficients. Thus, if the *F*-test is used instead of the Bonferroni method, fewer $\beta_0-\beta_1$ pairs will satisfy the null hypothesis that β_0 is zero and β_1 is the conversion ratio for a given significance (or confidence) level. However, since the null hypothesis in this study is an approximation and small departures from it are expected, the more efficient *F*-test may reject the null hypothesis for a convertible bond trading in region C of Figure 1. In other words, a bond trading near the converted value line may not be classified as a common stock equivalent by the *F*-test. This may result in overstatements of earnings per share and is contrary to the conservatism convention of the FASB's conceptual framework. Therefore, the more conservative Bonferroni method which involves two *t*-tests, one for the intercept and one for the slope coefficient, is the market test suggested here. The results of the *F*-test are also reported. Other statistical tests are certainly possible.[8]

EMPIRICAL RESULTS

The common stock equivalent classification of convertible bonds using the market test was compared to that obtained using the APB's and the FASB's rules. For this comparison, a random sample of 50 New York and American Exchange bonds convertible into common stock was drawn without replacement from the convertible bonds outstanding at the beginning of 1983 (as listed in *Standard & Poor's Bond Guide*) and was followed for three years.[9] The empirical question being addressed is whether a convertible bond was a common stock equivalent for a particular year (or portion of a year) for which it was outstanding.

Data Sources and Requirements

Since the proposed test is market-based, some choice concerning the minimum number of observations necessary to conduct the test was required. While increasing sample size does not affect the chance of a type I error (which is controlled by the choice of significance level), larger samples do reduce the likelihood of type II errors by increasing the power of the test. Examination of charts of the power function of *t*-tests show that the increase in power obtained from each additional observation is small once 12 degrees of freedom has been reached.[10] This corresponds to a minimum of 14 observations for a simple linear regression model, so 14 observations was selected as the cutoff. Weekly data will fulfill this data requirement for most companies.[11] Coupled with data losses from other sources (e.g., suspended security trading, bankruptcy, maturing bonds, bond call features exercised, loss of conversion feature), there were 42, 37, and 32 bonds out of the sample of 50 bonds with sufficient data for testing in 1983, 1984, and 1985, respectively.

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[8] Since regression lines fitted in region B can have slopes not significantly different from the conversion ratio, it is important that the intercept be statistically evaluated in addition to the slope coefficient. In other words, the slope of the convertible bond value line approximates the conversion ratio in a portion of region B.

[9] The test could be applied to bonds not traded on the New York or American Exchanges so long as market prices are available.

[10] For example, when the noncentrality parameter (i.e., the difference between the true coefficient and the coefficient under the null hypothesis divided by the standard error) equals four and the significance level equals .01 in a two-tailed test, the power of the *t*-test is 78 percent with 12 degrees of freedom, and 86 percent with 24 degrees of freedom, and 92 percent as the number of degrees of freedom approaches infinity. Power tables for the *t*-test may be found in Owen [1962, p. 34].

Closing weekly convertible bond prices were obtained from *Barron's* while the corresponding common stock prices were collected from *Standard & Poor's Daily Stock Price Record.* The stock prices were adjusted to reflect stock splits, stock dividends, and other events that affected the conversion ratios, which were obtained from *Standard & Poor's Bond Guide.*[12] All analysis was performed based upon the respective year-end conversion ratios (e.g., 1984 year-end conversion ratios were used for 1984 data). The tests were applied using an overall significance level of .02; that is, a significance level of .01 for each t-test using the Bonferroni method. The null hypothesis is rejected if either the estimated intercept differs significantly from zero or the estimated slope differs significantly from the conversion ratio.

To classify each security based upon the accounting principles applicable at its issuance, prime rates and average Aa corporate bond yields were collected from the *Federal Reserve Bulletin* and *Moody's Bond Record*, respectively. Cash yields were computed using the original public offering price.[13] These prices and bond issue dates were obtained from *Moody's Manuals* and annual reports.[14]

Simple Linear Regression Model

The results of the Bonferroni market test based upon the simple linear regression model presented in Equation 1 are reported in Tables 1-3. The estimated intercepts tended to be positive while the estimated slopes tended to be less than the respective conversion ratios, which is consistent with bonds trading in regions B and C of Figure 1. These tables also report the R^2 values of the fitted models which ranged from a low of .00 to a high of .99. Of the 111 values, 72 (65 percent) were .60 or higher. This indicates that extreme non-linearity was not present. However, as will be discussed and illustrated below, the data behaved as predicted, exhibiting curvature in some cases over lower price ranges and comparative linearity as prices increased. It is interesting to note that the average R^2 for the bonds classified as common stock equivalents was a relatively high .83. Thus, the theory seems especially descriptive of the actual price behavior in region C where a highly linear relation was both expected and found.[15]

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[11] There is little point in using daily data. For those bonds that actively trade throughout the year, only a small gain in power results from using daily instead of weekly data (see footnote 10). For those bonds that trade infrequently, going to daily data usually does little to increase the number of observations. For example, VLN's five percent convertible bond due 1987 had ten weekly trades during 1985 and only 11 daily trades.

[12] Large changes in conversion ratios were generally attributable to either stock splits or stock dividends and the occurrence of these was checked in other information sources (e.g., *Moody's Manuals, The Wall Street Journal Index*).

[13] Since all but one of the bonds in the sample were issued at or near par, effective yields and cash yields were virtually identical. The exception was American Israeli Paper, issued at 80.75, but this bond was not a common stock equivalent under either of these rules. SFAS No. 85 allows, but does not require, the retroactive application of the effective yield test.

[14] Corporations do not typically disclose in their annual reports whether a particular convertible bond is a common stock equivalent. This necessitated performing our own tests.

[15] There were also several convertible bonds that were not classified as common stock equivalents by the Bonferroni market test but had large R-squared's (e.g., Amerace and Caterpillar Tractor in 1984 and Dixico in 1985). Note that over a relatively short range of common stock prices (which may occur in any given year) there are

TABLE 1
SIMPLE LINEAR REGRESSION MODEL RESULTS FOR 1983
(market price of convertible bond = f(market price of common stock))

Issue					Intercept		Slope				Common Stock Equivalent?	
Firm	Rate	Due Date	Conversion Ratio	No. of Obs.	Estimate	t-Statistic (Est. vs. Zero)	Estimate	t-Statistic (Est. vs. Conversion Ratio)	R^2	F-Statistic (Est. vs. Zero and Conversion Ratio)	Bonferroni	APB/FASB
Altec	15.00	1995	833.33	35	545.2	10.73	465.9	−9.07	.80	91.35	No	No
Amerace	5.00	1992	27.03	37	576.8	19.36	8.6	−15.36	.60	837.13	No	No
American Israeli Paper	11.75	1997	58.58	50	733.4	83.34	8.9	−49.68	.62	17,447.00	No	No
Bally Manufacturing	10.00	2006	30.60	52	651.8	30.18	14.0	−18.44	.81	11,851.41	No	Yes
Caterpillar Tractor	5.50	2000	19.80	52	420.0	8.11	12.4	−6.17	.69	472.55	No	No
Celanese	9.75	2006	14.08	50	475.2	20.66	8.9	−12.95	.93	1,159.94	No	Yes
Dixico	8.50	1993	125.00	42	489.2	21.00	62.1	−14.63	.84	597.33	No	No
Eastern Airlines	11.50	1999	62.50	52	373.8	18.69	48.8	−5.71	.89	2,192.29	No	No
Energy Resources	9.00	1995	64.60	39	433.4	13.42	61.3	−.66[a]	.80	813.99	No	Yes
First Pennsylvania	5.00	1993	23.26	52	419.6	27.97	19.4	−1.68[a]	.59	12,873.53	No	Yes
Foremost-McKesson	9.75	2006	22.86	51	526.3	19.00	13.1	−16.27	.89	1,294.69	No	Yes
Galaxy Oil	9.00	1994	93.02	52	559.6	23.71	−1.3	−9.53	.00	2,519.64	No	No
GTE	5.00	1992	22.98	50	6.0	.10[a]	22.5	−.34[a]	.84	15.22	Yes	No
Harte-Hanks Communications	8.00	2005	28.17	19	380.4	4.86	19.7	−4.46	.86	25.48	No	No
Hercules	6.50	1994	28.57	52	301.8	10.74	21.1	−9.34	.94	138.73	No	Yes
Hughes Tool	9.50	2006	21.22	52	864.2	28.33	1.9	−12.88	.03	14,722.30	No	Yes
International Paper	4.25	1996	39.48	38	−5.7	−.06[a]	39.6	.05[a]	.88	.00[b]	Yes	No
Interstate Bakeries	5.75	1987	55.65	22	552.5	9.49	21.8	−7.52	.54	5,648.13	No	No
Kaiser Cement	9.00	2005	30.53	50	527.1	17.00	18.0	−9.64	.80	1,342.21	No	No
Keystone International	8.50	2005	44.13	48	656.2	15.89	20.4	−12.49	.71	1,131.95	No	Yes
Lifemark	13.00	2001	36.06	52	838.8	20.87	15.0	−16.20	.72	666.43	No	No
Lockheed	4.25	1992	47.24	39	62.4	.87[a]	45.4	−1.02[a]	.95	1.24[b]	Yes	No
McDonnell Douglas	4.75	1991	32.67	33	−45.1	−.48[a]	32.9	.14[a]	.92	5.87	Yes	No
MCO Holdings	5.00	1997	34.29	30	569.1	39.80	4.0	−30.29	.36	5,182.78	No	Yes
MONY Mortgage Investors	7.00	1990	90.91	46	53.2	1.32[a]	90.3	−.13[a]	.89	82.33	Yes	No
National Medical Enterprises	9.00	2006	47.32	52	498.6	18.13	24.8	−20.47	.92	577.78	No	Yes
Newberry Energy	12.00	1995	98.43	51	502.9	26.19	56.1	−20.16	.94	518.26	No	No
Northeast Airlines	6.50	1986	8.00	35	943.5	42.31	−1.9	−19.80	.28	17,786.88	No	No
Perry Drug Stores	12.85	1997	111.11	25	268.4	5.66	92.6	−5.61	.97	34.99	No	No
Pogo Producing	8.00	2005	25.32	52	620.0	16.49	7.4	−11.20	.30	1,619.14	No	Yes
Research-Cottrell	10.50	2006	58.82	52	633.8	23.65	28.4	−19.01	.87	1,177.76	No	Yes
Revere Copper & Brass	5.50	1992	29.41	52	337.0	14.46	27.9	−.72[a]	.79	2,409.28	No	No
Reynolds Metals	4.50	1991	17.46	52	415.2	14.32	9.2	−9.18	.70	752.23	No	No
Southwest Airlines	10.00	2007	43.38	23	202.5	1.56[a]	39.0	−1.12[a]	.83	11.40	Yes	No
Sterling Bank	float	1992					Not Applicable					
Suave Shoe	5.00	1997	48.90	45	471.5	9.72	15.0	−6.65	.17	573.05	No	No
Susquehanna	5.50	1988	32.13	32	665.3	25.11	2.0	−6.55	.01	6,222.94	No	No
Thermo Electron	8.50	2005	23.39	52	508.4	24.09	13.4	−12.49	.86	3,808.44	No	No
VLN	5.00	1987	41.00	23	70.1	.55[a]	30.2	−.91[a]	.75	6.20	Yes	No
Wang Laboratories	9.50	2005	40.00	19	339.4	8.61	12.3	−8.91	.98	38.34	No	Yes
Western Union	5.25	1997	15.15	52	249.9	8.22	5.1	−3.56	.84	816.01	No	No
Whittaker	4.50	1988	21.28	36	636.2	30.73	17.3	−23.11	.59	2,012.92	No	No
Will Ross	5.25	1989	22.75	30	263.0	4.19	36.8	−3.89	.85	10.26	No	Yes

[a] Not significant in a two-tail test at the .01 level.

[b] Not significant at the .02 level.

The other seven issues selected did not have at least 14 weekly observations in any of the three years. They were Black & Decker, four percent, 1992; Crystal Oil, nine percent, 1991; Fairchild Industries, 4.375 percent, 1992; General Instrument, 4.25 percent, 1985; Great Northern Nekoosa, 4.25 percent, 1991; Melville Corporation, 4.875 percent, 1996; and Mesa Petroleum, 8.5 percent, 2000.

Based upon the Bonferroni market test, there were seven (17 percent) common stock equivalents in 1983, six (16 percent) in 1984, and four (13 percent) in 1985. Of these 17 cases, the APB/FASB rules only identified two as common stock equivalents. Thus, the APB/FASB rules generally failed to identify convertible bonds that trade as if they were common stock in this particular sample. Moreover, the APB/FASB rules identified 14 bonds (40 percent) as common stock equivalents in 1983 out of the 35

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portions of the convertible bond value curve in Figure 1 that are nearly linear. Thus, a high R-squared is not sufficient for identifying convertible bonds trading in region C.

TABLE 2

SIMPLE LINEAR REGRESSION MODEL RESULTS FOR 1984
(market price of convertible bond = f(market price of common stock))

Issue					Intercept		Slope				Common Stock Equivalent?	
Firm	Rate	Due Date	Conversion Ratio	No. of Obs.	Estimate	t-Statistic (Est. vs. Zero)	Estimate	t-Statistic (Est. vs. Conversion Ratio)	R^2	F-Statistic (Est. vs. Zero and Conversion Ratio)	Bonferroni	APB/FASB
Altec	15.00	1995					Not Applicable					
Amerace	5.00	1992	27.03	29	90.7	3.58[a]	24.6	−4.05	.98	8.08	No	No
American Israeli Paper	11.75	1997	58.58	44	700.7	26.74	8.8	−11.06	.08	15,573.03	No	No
Bally Manufacturing	10.00	2006	30.60	52	599.3	22.62	14.4	−10.08	.66	3,479.86	No	Yes
Caterpillar Tractor	5.50	2000	19.80	52	265.9	26.07	15.9	−13.00	.99	2,098.89	No	No
Celanese	9.75	2006	14.08	52	371.8	9.37	10.2	−6.47	.87	845.31	No	Yes
Dixico	8.50	1993	125.00	48	330.3	6.78	86.0	−5.49	.76	122.87	No	No
Eastern Airlines	11.50	1999	62.50	52	446.3	44.19	37.9	−12.95	.89	13,919.44	No	No
Energy Resources	9.00	1995	64.60	18	167.4	2.00[a]	175.9	2.27[a]	.44	934.31	Yes	Yes
First Pennsylvania	5.00	1993	23.26	47	601.7	21.04	−4.0	−5.68	.02	8,879.98	No	Yes
Foremost-McKesson	9.75	2006	22.86	52	453.9	10.18	14.6	−6.88	.75	1,553.98	No	Yes
Galaxy Oil	9.00	1994	93.02	37	608.3	30.88	−4.6	−10.97	.01	5,945.55	No	No
GTE	5.00	1992	22.98	48	−11.0	−.23[a]	22.8	−.15[a]	.88	21.92	Yes	No
Harte-Hanks Communications	8.00	2005					Not Applicable					
Hercules	6.50	1994	28.57	51	397.3	9.83	18.1	−8.73	.81	256.70	No	Yes
Hughes Tool	9.50	2006	21.22	52	552.4	22.73	15.7	−3.68	.70	7,904.86	No	Yes
International Paper	4.25	1996	39.48	25	116.0	1.93[a]	34.9	−1.99[a]	.91	1.97[b]	Yes	No
Interstate Bakeries	5.75	1987	56.09	18	513.4	8.29	24.8	−7.28	.68	87.20	No	No
Kaiser Cement	9.00	2005	30.53	38	325.9	9.82	26.6	−2.46[a]	.88	1,722.17	No	No
Keystone International	8.50	2005	49.31	37	535.0	9.74	26.1	−7.03	.64	513.41	No	Yes
Lifemark	13.00	2001	61.80	36	255.2	1.91[a]	52.2	−1.71[a]	.71	8.27	Yes	No
Lockheed	4.25	1992					Not Applicable					
McDonnell Douglas	4.75	1991	32.67	21	172.0	2.06[a]	29.9	−2.13[a]	.97	7.00	Yes	No
MCO Holdings	5.00	1997	33.88	24	579.0	19.13	3.1	−12.83	.07	6,013.43	No	Yes
MONY Mortgage Investors	7.00	1990	90.91	41	657.4	10.65	16.9	−9.37	.11	215.35	No	No
National Medical Enterprises	9.00	2006	40.32	52	594.2	22.01	20.9	−16.18	.85	4,082.92	No	Yes
Newberry Energy	12.00	1995	98.43	52	680.7	26.18	32.4	−16.11	.55	2,356.87	No	No
Northeast Airlines	6.50	1986	8.00	30	767.7	28.22	3.3	−5.88	.40	18,436.61	No	No
Perry Drug Stores	12.85	1997					Not Applicable					
Pogo Producing	8.00	2005	25.32	51	369.8	11.56	17.4	−4.95	.71	2,496.61	No	Yes
Research-Cottrell	10.50	2006	58.82	50	613.4	16.40	30.0	−12.53	.78	2,131.30	No	Yes
Revere Copper & Brass	5.50	1992	29.41	52	564.2	6.26	9.2	−2.63[a]	.03	2,239.73	No	No
Reynolds Metals	4.50	1991	17.46	52	292.1	8.64	12.7	−4.33	.74	775.01	No	No
Southwest Airlines	10.00	2007	54.23	41	411.2	10.41	38.4	−8.33	.92	181.12	No	No
Sterling Bank	float	1992	111.11	14	137.0	.94[a]	94.8	−1.16[a]	.79	5.20[b]	Yes	No
Suave Shoe	5.00	1997	48.90	38	460.1	33.83	22.9	−13.68	.80	8,359.92	No	No
Susquehanna	5.50	1988	33.19	27	561.3	15.25	32.3	−.12[a]	.44	8,908.28	No	No
Thermo Electron	8.50	2005	35.09	51	689.2	17.63	10.7	−11.09	.33	2,079.43	No	No
VLN	5.00	1987					Not Applicable					
Wang Laboratories	9.50	2005					Not Applicable					
Western Union	5.25	1997	15.15	52	291.5	32.03	10.7	−11.13	.94	2,413.94	No	No
Whittaker	4.50	1988	21.28	25	768.3	13.55	1.3	−6.89	.01	5,348.44	No	No
Will Ross	5.25	1989	22.75	31	208.9	4.90	18.6	−5.19	.94	12.05	No	Yes

[a] Not significant in a two-tail test at the .01 level.

[b] Not significant at the .02 level.

The other seven issues selected did not have at least 14 weekly observations in any of the three years. They were Black & Decker, four percent, 1992; Crystal Oil, nine percent, 1991; Fairchild Industries, 4.375 percent, 1992; General Instrument, 4.25 percent, 1985; Great Northern Nekoosa, 4.25 percent, 1991; Melville Corporation, 4.875 percent, 1996; and Mesa Petroleum, 8.5 percent, 2000.

bonds that were not trading as such, 12 bonds (39 percent) in 1984, and ten bonds (36 percent) in 1985. Overall, the classifications produced by the two methods agreed only 50 percent of the time (21 bonds) in 1983, 54 percent of the time (20 bonds) in 1984, and 59 percent of the time (19 bonds) in 1985. Assuming no classification errors by the Bonferroni market test, the APB/FASB rules did only marginally better than results obtainable by flipping a coin. Thus, the classifications produced by the APB/FASB rules do not seem to reflect the theoretical valuation of convertible bonds.

Results for the F-test, which simultaneously tests the null hypothesis that β_0

TABLE 3

SIMPLE LINEAR REGRESSION MODEL RESULTS FOR 1985
(market price of convertible bond $=f$(market price of common stock))

Issue			*Conversion Ratio*	*No. of Obs.*	*Intercept*		*Slope*			*F-Statistic (Est. vs. Zero and Conversion Ratio)*	*Common Stock Equivalent?*	
Firm	*Rate*	*Due Date*			*Estimate*	*t-Statistic (Est. vs. Zero)*	*Estimate*	*t-Statistic (Est. vs. Conversion Ratio)*	R^2		*Bonferroni*	*APB/FASB*
Altec	15.00	1995					Not Applicable					
Amerace	5.00	1992					Not Applicable					
American Israeli Paper	11.75	1997	58.58	49	532.8	11.17	43.6	−2.11[a]	.45	3,387.55	No	No
Bally Manufacturing	10.00	2006	30.60	52	389.7	8.45	30.5	−.03[a]	.69	4,215.64	No	Yes
Caterpillar Tractor	5.50	2000	19.80	52	202.8	6.02	18.8	−1.00[a]	.88	1,657.65	No	No
Celanese	9.75	2006	14.08	51	5.9	.30[a]	13.9	−.90[a]	.99	18.77	Yes	Yes
Dixico	8.50	1993	125.00	33	275.8	11.94	95.5	−11.35	.98	73.73	No	No
Eastern Airlines	11.50	1999	62.50	52	441.6	14.25	51.5	−2.82	.77	1,034.73	No	No
Energy Resources	9.00	1995					Not Applicable					
First Pennsylvania	5.00	1993	23.26	35	589.9	8.43	9.4	−1.37[a]	.03	3,549.43	No	Yes
Foremost-McKesson	9.75	2006	22.86	52	493.5	17.14	14.2	−14.43	.91	842.68	No	Yes
Galaxy Oil	9.00	1994	93.02	37	725.4	19.93	−21.1	−6.48	.04	1,823.49	No	No
GTE	5.00	1992	22.98	48	65.2	1.33[a]	21.1	−1.57[a]	.87	24.25	Yes	No
Harte-Hanks Communications	8.00	2005					Not Applicable					
Hercules	6.50	1994	28.57	52	271.7	7.11	28.1	−.43[a]	.89	104.03	No	Yes
Hughes Tool	9.50	2006	21.22	52	873.0	20.89	−1.5	−7.57	.01	16,354.80	No	Yes
International Paper	4.25	1996	39.48	29	32.5	.93[a]	37.6	−1.71[a]	.98	14.65	Yes	No
Interstate Bakeries	5.75	1987	56.09	20	614.4	9.53	20.3	−9.42	.61	45.69	No	No
Kaiser Cement	9.00	2005	30.53	47	632.5	10.89	10.9	−5.61	.18	2,539.43	No	No
Keystone International	8.50	2005	61.65	46	686.0	12.41	23.9	−9.67	.47	1,388.31	No	Yes
Lifemark	13.00	2001					Not Applicable					
Lockheed	4.25	1992					Not Applicable					
McDonnell Douglas	4.75	1991					Not Applicable					
MCO Holdings	5.00	1997	33.88	20	486.0	6.74	11.6	−4.13	.21	4,129.94	No	Yes
MONY Mortgage Investors	7.00	1990	90.91	44	494.4	4.55	42.1	−4.10	.23	69.06	No	No
National Medical Enterprises	9.00	2006	40.32	52	720.0	44.72	17.3	−38.37	.94	2,599.15	No	Yes
Newberry Energy	12.00	1995	103.31	51	780.4	34.68	28.8	−15.52	.43	16,696.52	No	No
Northeast Airlines	6.50	1986	8.00	34	980.4	37.85	−.4	−14.00	.01	37,865.47	No	No
Perry Drug Stores	12.85	1997					Not Applicable					
Pogo Producing	8.00	2005	25.32	52	597.5	35.57	4.8	−18.66	.28	6,431.18	No	Yes
Research-Cottrell	10.50	2006	58.82	51	371.5	12.10	42.9	−11.37	.95	84.28	No	Yes
Revere Copper & Brass	5.50	1992	29.41	29	713.9	16.37	7.9	−5.98	.15	13,771.20	No	No
Reynolds Metals	4.50	1991	17.62	52	673.7	13.89	2.7	−10.66	.07	1,321.45	No	No
Southwest Airlines	10.00	2007	54.23	26	292.7	4.29	42.8	−4.23	.91	9.30	No	No
Sterling Bank	float	1992	111.11	17	428.7	1.85[a]	70.3	−1.93[a]	.42	4.27[b]	Yes	No
Suave Shoe	5.00	1997	48.90	20	458.0	7.58	18.0	−2.76[a]	.13	2,711.96	No	No
Susquehanna	5.50	1988	32.80	23	817.9	34.95	−2.6	−8.05	.02	20,994.98	No	No
Thermo Electron	8.50	2005	52.63	52	513.0	23.00	31.9	−17.28	.93	855.72	No	No
VLN	5.00	1987					Not Applicable					
Wang Laboratories	9.50	2005					Not Applicable					
Western Union	5.25	1997	15.15	52	240.8	28.33	18.0	4.07	.92	13,426.04	No	No
Whittaker	4.50	1988	21.28	24	867.8	25.30	−1.0	−14.85	.02	12,122.16	No	No
Will Ross	5.25	1989					Not Applicable					

[a] Not significant in a two-tail test at the .01 level.

[b] Not significant at the .02 level.

The other seven issues selected did not have at least 14 weekly observations in any of the three years. They were Black & Decker, four percent, 1992; Crystal Oil, nine percent, 1991; Fairchild Industries, 4.375 percent, 1992; General Instrument, 4.25 percent, 1985; Great Northern Nekoosa, 4.25 percent, 1991; Melville Corporation, 4.875 percent, 1996; and Mesa Petroleum, 8.5 percent, 2000.

is zero and β_1 is the conversion ratio, are also reported in Tables 1-3. Five common stock equivalents were identified over the three years using this method. All of these common stock equivalents were also identified using the Bonferroni method. Table 4 shows that there is little agreement between the classifications produced by the Bonferroni method or the F-test and the APB/FASB rules.[16] This disagreement is probably a function not only of the classification method used but also of the frequency of its application.

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[16] There are a total of 29 cases (including the 17 cases identified by the Bonferroni method) where the estimated slope term was not significantly different from the conversion ratio. Of these 29 cases, six were classified as common stock equivalents by the APB/FASB rules. It is interesting to note that the average intercept term for

TABLE 4
NUMBERS OF COMMON STOCK EQUIVALENTS

Significance Level	*Bonferroni Method*		F-*Test*	
	Number	*Agreement with APB/FASB*	*Number*	*Agreement with APB/FASB*
.002	17	2	8	0
.02	17	2	5	0
.10	15	1	3	0
.20	11	1	2	0

Table 4 also shows the results for other overall significance levels. For both the Bonferroni method and the *F*-test, there are only six changes in classifications in the 111 cases examined as the significance level goes from .002 to .20. The results are especially stable using the Bonferroni method for significance levels ranging from .002 to .10. Thus, even though the choice of significance level depends upon some unknown loss function, the market test using the Bonferroni method is fairly insensitive to this choice. Moreover, unlike arbitrary percentage cutoffs, the selected significance levels have meaning (i.e., the proportion of type I errors expected in the long run).

Like the choice of significance level, the choice of a classification method cannot be made definitively without knowing the social welfare function [May and Sundem, 1976]. However, the market test is based on an underlying theory, and therefore provides a well-defined meaning to the phrase "common stock equivalent." It is difficult to believe that a method that is applied only at time of issue and that ignores security price behavior is a superior test.

Polynomial Regression Models

As noted above, the data are expected to be non-linear in portions of regions A and B of Figure 1. However, unless this curvature is appreciable in the range of observed prices, the inclusion of higher-order (polynomial) terms in the regression model will not be of consequence since a straight line will provide a reasonably good fit to the data. Given that the need for polynomial terms needs to be evaluated on a case-by-case basis, the analysis was repeated using a model selection procedure. If the data are characterized by the double curve shown in Figure 1, a third-order polynomial model is appropriate [Neter and Wasserman, 1974, pp. 275–276]:

$$Y_t = \beta_0 + \beta_1 X_t + \beta_2 X_t^2 + \beta_3 X_t^3 + \epsilon_t \qquad (2)$$

On the other hand, if only a single curve is present in the data, a second-order polynomial model is sufficient [Neter and Wasserman, 1974, pp. 273–275]:

$$Y_t = \beta_0 + \beta_1 X_t + \beta_2 X_t^2 + \epsilon_t \qquad (3)$$

The appropriate model can be identified by estimating equation 2 and testing b_3 (b_i is the estimate of β_i, $i=0,1,2,3$) using a *t*-test to see if it is significantly different from zero. If it is, the data con-

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convertible bonds identified by the Bonferroni method was $101 while it was more than four times higher ($411) for the additional 12 cases where the estimated slope term was not significantly different from the conversion ratio. This is indicative of these latter bonds trading in region B of Figure 1 (see footnote 8).

TABLE 5

POLYNOMIAL REGRESSION MODELS

Year	*Model Selection Frequency (Percent*)* *Linear*	 *Second-Order*	 *Third-Order*	*Total Models*
1983	30 (71%)	11 (26%)	1 (2%)	42
1984	30 (81%)	3 (8%)	4 (11%)	37
1985	21 (66%)	10 (31%)	1 (3%)	32
Totals	81 (73%)	24 (22%)	6 (5%)	111

* Percentages are rounded and so may not sum to 100 percent.

tain a double curve and equation 2 is the appropriate model. Alternatively, if b_3 is not significantly different from zero, the model selection process continues with the fitting of equation 3. Should b_2 from equation 3 be found to be significantly different from zero using a *t*-test, the data contain a single curve and equation 3 is the appropriate model. If this is not the case, the appropriate model is that of equation 1 (i.e., a simple linear model).

This model selection process was applied to each of the 111 cases analyzed above to determine the model most appropriate for each bond for each year. The Bonferroni method was used to identify common stock equivalents. Since an essentially linear relation between the common stock and convertible bond prices is expected for common stock equivalents, bonds for which higher-order (non-linear) terms were significant were not classified as common stock equivalents. Formally, for a bond to be classified as a common stock equivalent, b_1 must not be significantly different from the conversion ratio and b_0, b_2, and b_3 (if present) all must not be significantly different from zero.

The results of this refinement based upon the same .02 combined significance level used in Tables 1–3 are presented in Table 5. Over the three years, they show that the linear model (equation 1) was selected for 73 percent of the cases, the second-order model (equation 3) for 22 percent, and the third-order model (equation 2) for just five percent. This indicates that the data for some of the bonds may be non-linear. On the other hand, it turned out that using the model selection procedure (as opposed to simply using equation 1 in all cases) resulted in only two classification changes [Lifemark, 1984 and Sterling Bank, 1985] out of the 111 cases considered. Hence, the proposed market test also seems relatively insensitive to model selection.[17]

TWO CASE STUDIES

In this section, two of the convertible bonds from the sample are examined in greater detail. Plots of the data and other information are provided. The two bonds are GTE five percent due 1992 and

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[17] The sensitivity of the model selection approach to choice of significance level was examined by repeating the tests using a .01 overall significance level. This resulted in only one classification change with Sterling Bank, 1985, now classified as a common stock equivalent. After this adjustment, only one classification difference [Lifemark, 1984] remained between the model selection procedure and the simple linear regression approach.

TABLE 6

ESTIMATED REGRESSION EQUATIONS FOR GTE FIVE PERCENT CONVERTIBLE BOND DUE 1992

Year	*Model*	*Number of Observations*	*Conversion Ratio*	R^2	*Coefficient*	*Value*	*Standard Error*
1983	simple linear	50	22.98	.84	b_0	5.99[a]	60.75
					b_1	22.47[b]	1.41
1984	simple linear	48	22.98	.88	b_0	−10.99[a]	48.34
					b_1	22.84[b]	1.23
1985	simple linear	48	22.98	.87	b_0	65.15[a]	49.20
					b_1	21.08[b]	1.19

[a] Not significantly different from zero in a two-tailed t-test at $\alpha=.01$ (i.e., .02/2).
[b] Not significantly different from conversion ratio in a two-tailed t-test at $\alpha=.01$.

TABLE 7

ESTIMATED REGRESSION EQUATIONS FOR CELANESE 9.75 PERCENT CONVERTIBLE BOND DUE 2006

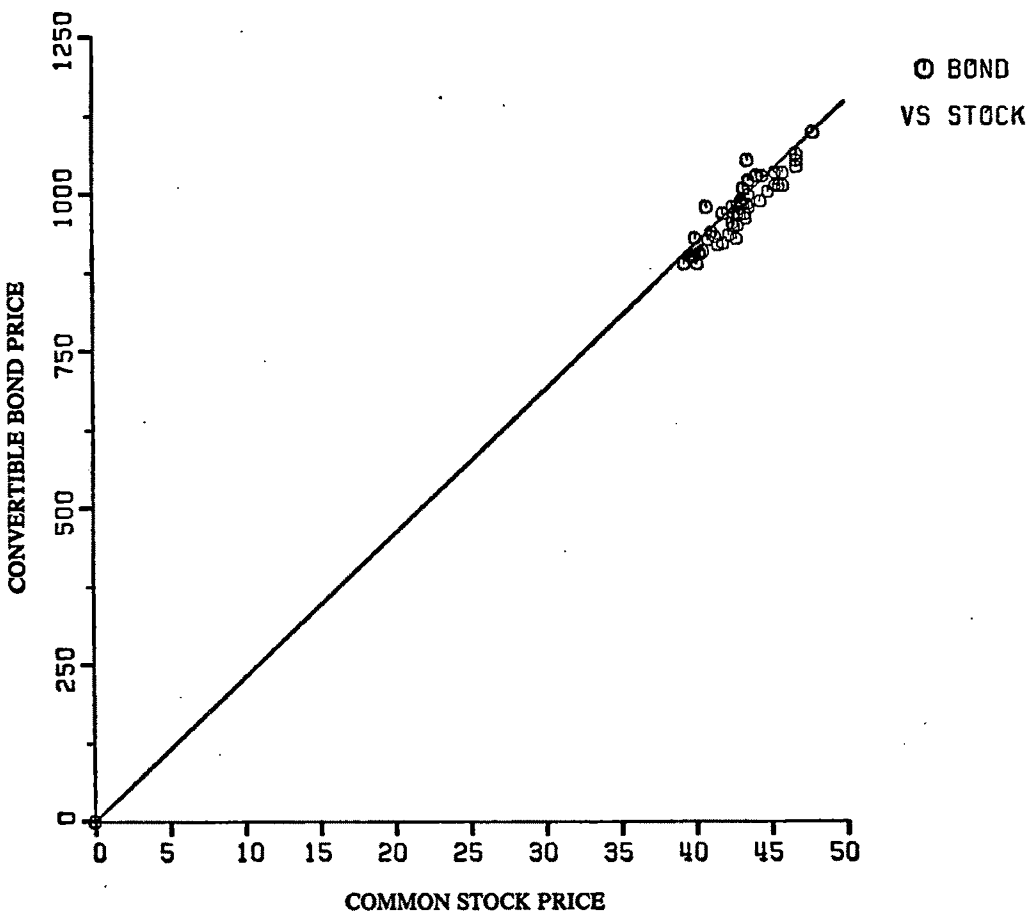
Year	*Model*	*Number of Observations*	*Conversion Ratio*	R^2	*Coefficient*	*Value*	*Standard Error*
1983	second-order	50	14.08	.96	b_0	−393.14[c]	160.47
					b_1	36.35	5.04
					b_2	−.21	.04
1983	simple linear	50	14.08	.93	b_0	475.17	23.01
					b_1	8.94	.35
1984	simple linear	52	14.08	.87	b_0	371.84	39.70
					b_1	10.18	.55
1985	simple linear	51	14.08	.99	b_0	5.89[a]	19.70
					b_1	13.85[b]	.17

[a] Not significantly different from zero in a two-tailed t-test at $\alpha=.01$ (i.e., .02/2).
[b] Not significantly different from conversion ratio in a two-tailed t-test at $\alpha=.01$.
[c] Not significantly different from zero in a two-tailed t-test at $\alpha=.0067$ (i.e., .02/3).

Celanese 9.75 percent due 2006. The GTE bonds were selected since they were classified as common stock equivalents in each of the three years using the Bonferroni method but not by the F-test or the APB/FASB rules. The Celanese bonds were selected to show the transition over the three years of a bond not classified as a common stock equivalent into one that was so classified using the Bonferroni procedure and the market test. These bonds were not classified as common stock equivalents in any of the three years by the F-test, but were classified as common stock equivalents by the APB/FASB rules.

The GTE bonds were offered in denominations of $1,000 at 100 percent on December 19, 1967. Throughout 1983–85, each $1,000 bond was convertible into 22.98 shares of GTE common stock. At the beginning of 1983, $101 million were outstanding ($150 million authorized) and $36.4 million were still out-

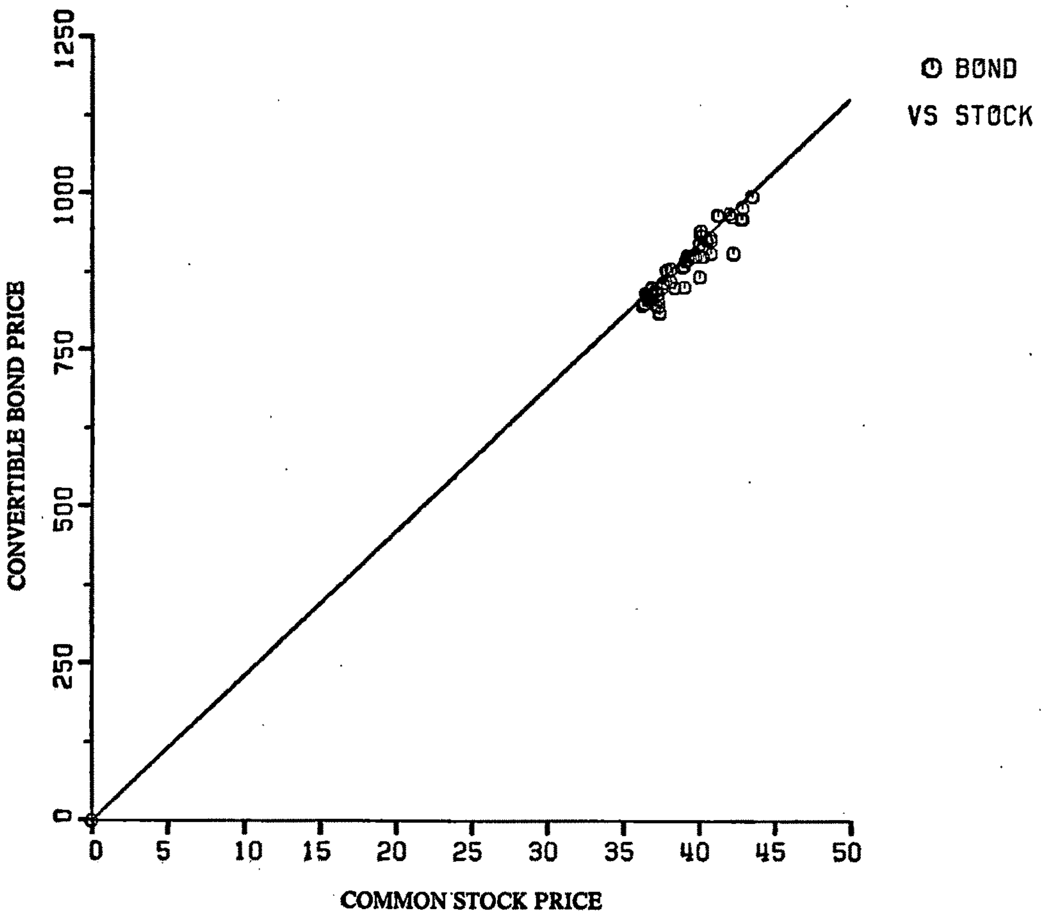
FIGURE 2
CONVERTIBLE BOND PRICE VERSUS COMMON STOCK PRICE
GTE CORPORATION
1983



standing at the end of 1985. The Celanese bonds were offered at 100 percent on March 6, 1981, in denominations of $1,000. Throughout 1983–85, each $1,000 bond was convertible into 14.08 shares of Celanese common stock and $100 million (authorized limit) of bonds were outstanding. Both bonds are traded on the New York Bond Exchange, pay interest on June and December 15, are unsecured, and are callable.

Tables 6 and 7 show the estimated equations for each of these bonds using the model selection approach. The equations are linear except for Celanese in 1983. The estimated simple linear equation is also provided for the latter case. For the four cases in which the bonds were classified as common stock equivalents by the Bonferroni method, the estimated coefficients were within one standard error of the theoretical common stock equivalent values (i.e., intercept of zero and slope coefficient equal to the conversion ratio) except for GTE in 1985. It appears that market partici-

FIGURE 3
CONVERTIBLE BOND PRICE VERSUS COMMON STOCK PRICE
GTE CORPORATION
1984

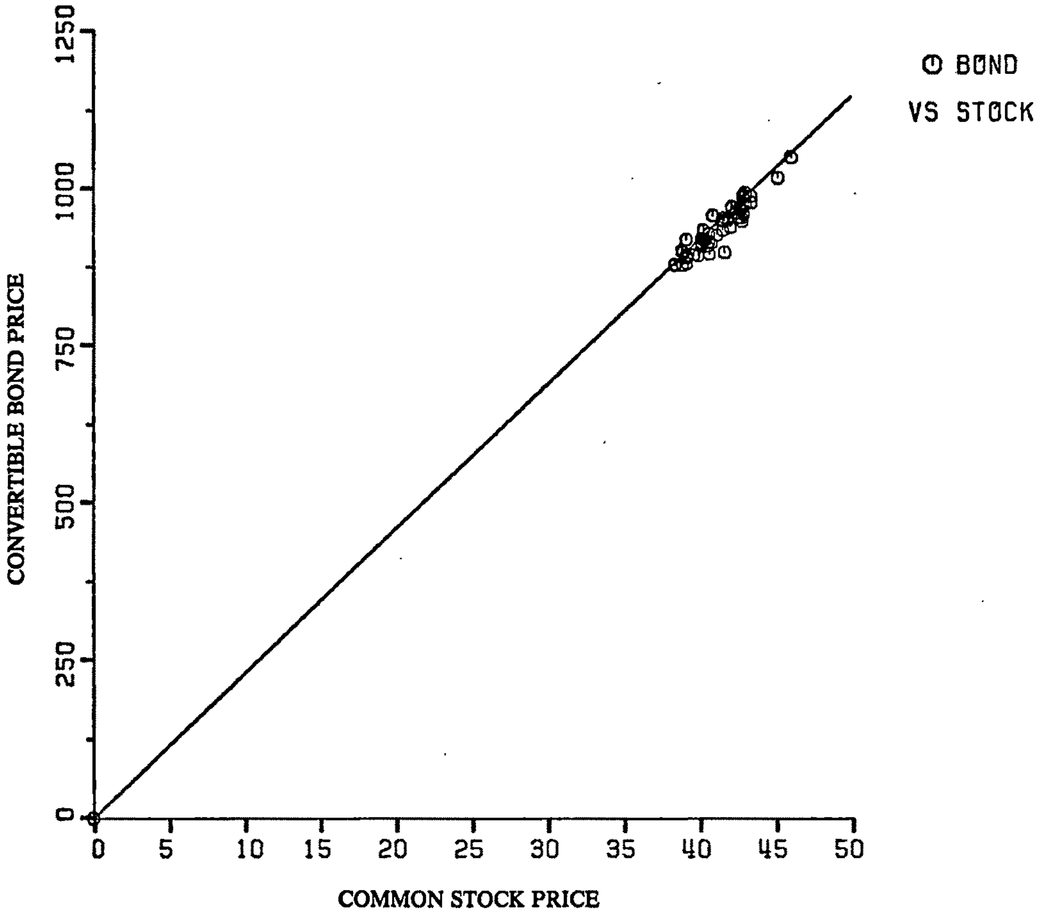


pants are pricing the bonds in these four cases as if they were nearly equivalent to common stock.

Plots of the data bear this out. Figure 2 shows a plot of GTE's convertible bond price versus its common stock price for 1983. The diagonal line is the converted value line. Visually, there is a stong relation between the points and the converted value line. Similar strong relations are evident in Figure 3 (GTE data for 1984) and Figure 4 (GTE data for 1985). In view of this evidence, it would be difficult to support the APB/FASB or *F*-test classifications of this bond as not a common stock equivalent.

Figure 5 shows a plot of Celanese's convertible bond price versus common stock price for 1983. Here, the bond is trading consistently above the converted value line and is not classified as a common stock equivalent by the Bonferroni method (but is by the APB/FASB rules). Note that the slight downward curvature in the left-hand portion of this plot resulted in a second-order polynomial

FIGURE 4
CONVERTIBLE BOND PRICE VERSUS COMMON STOCK PRICE
GTE CORPORATION
1985



(equation 3) being fitted by the model selection process. In Figure 6 (Celanese data for 1984) the plot is moving closer to the converted value line but still is not classified as a common stock equivalent by the Bonferroni method. This plot looks much more linear, and the linear model was chosen by the model selection process. In Figure 7 (Celanese data for 1985), the plot has now moved along the converted value line and the bond is now classified as a common stock equivalent by the Bonferroni method (but not by the F-test).[18]

The Celanese plots are especially interesting in that they show the transition of a bond from trading above the converted value line to one trading along the converted value line. Unlike the APB/FASB

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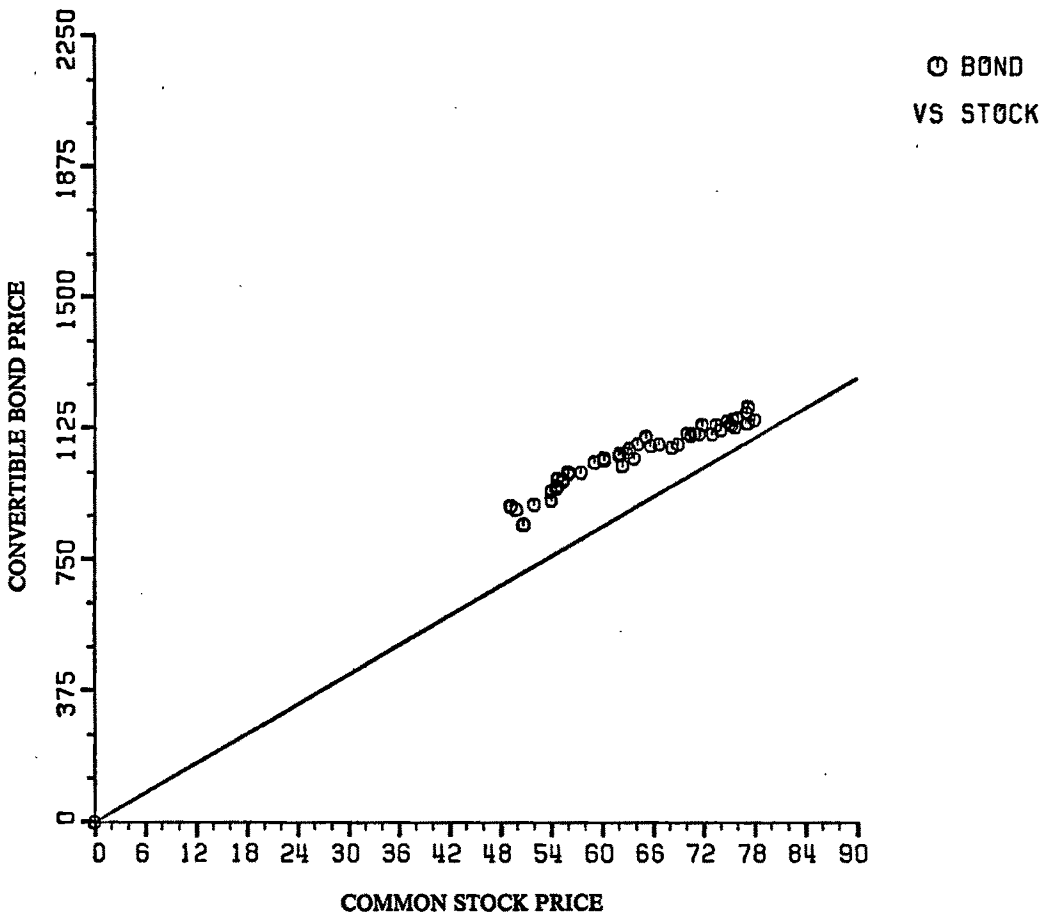
[18] The converted value line does not intersect the origin in this plot since the horizontal axis has been shifted so that the relatively high stock prices could be effectively plotted. The scale is the same as in the earlier Celanese plots.

FIGURE 5
CONVERTIBLE BOND PRICE VERSUS COMMON STOCK PRICE
CELANESE CORPORATION
1983

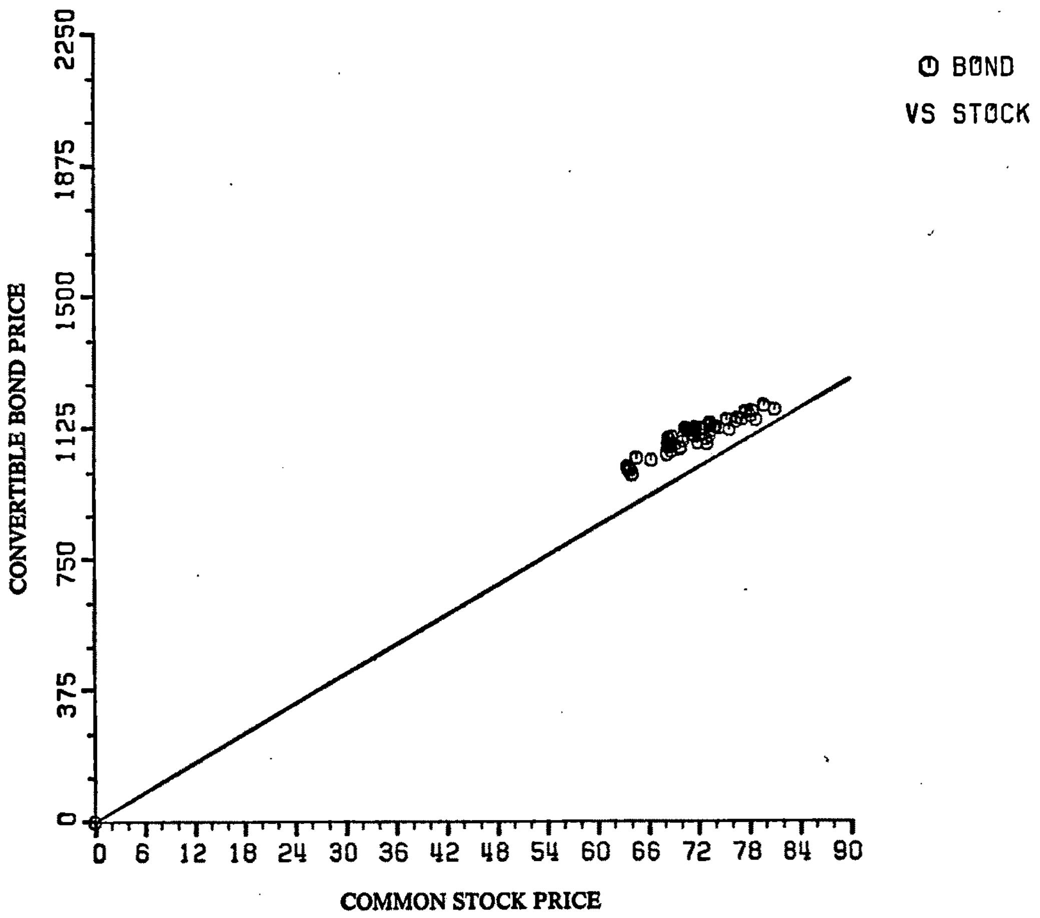


rules, the Bonferroni market test recognizes this difference and classifies the bond according to the observed market prices of a given year. Figure 8 shows the plot for all three years of data for Celanese. The similarity between this plot and Figure 1 is intriguing. The empirical results for Celanese seem consistent with the theoretical relations discussed earlier. These relations also provide a framework within which other bond classification methods can be evaluated.

ALTERNATIVE CLASSIFICATION METHODS

One alternative method considered by the APB when it drafted Opinion No. 15 was the market parity test. Like the Bonferroni market test, this method is consistent with the theoretical valuation of convertible bonds discussed above. In the market parity test the converted value of the convertible bond is compared to its market value. If these two single values are about the same and if

Figure 6
Convertible Bond Price Versus Common Stock Price
Celanese Corporation
1984



they exceed the redemption price, the convertible security is considered a common stock equivalent [AICPA, 1969, paragraph 82]. However, the APB criticized and rejected this method primarily because a percentage cutoff was used to classify securities.[19] In addition to using significance levels rather than arbitrary percentage cutoffs, the advantage of the market test over the market parity test is that it provides a single test on multiple observations taking statistical account of their inherent variability. Price variability is not considered under the market parity test.

Another classification approach considered and rejected by the APB was the investment value method. Under this method, a convertible security is classified as a common stock equivalent if its market value exceeds its straight security

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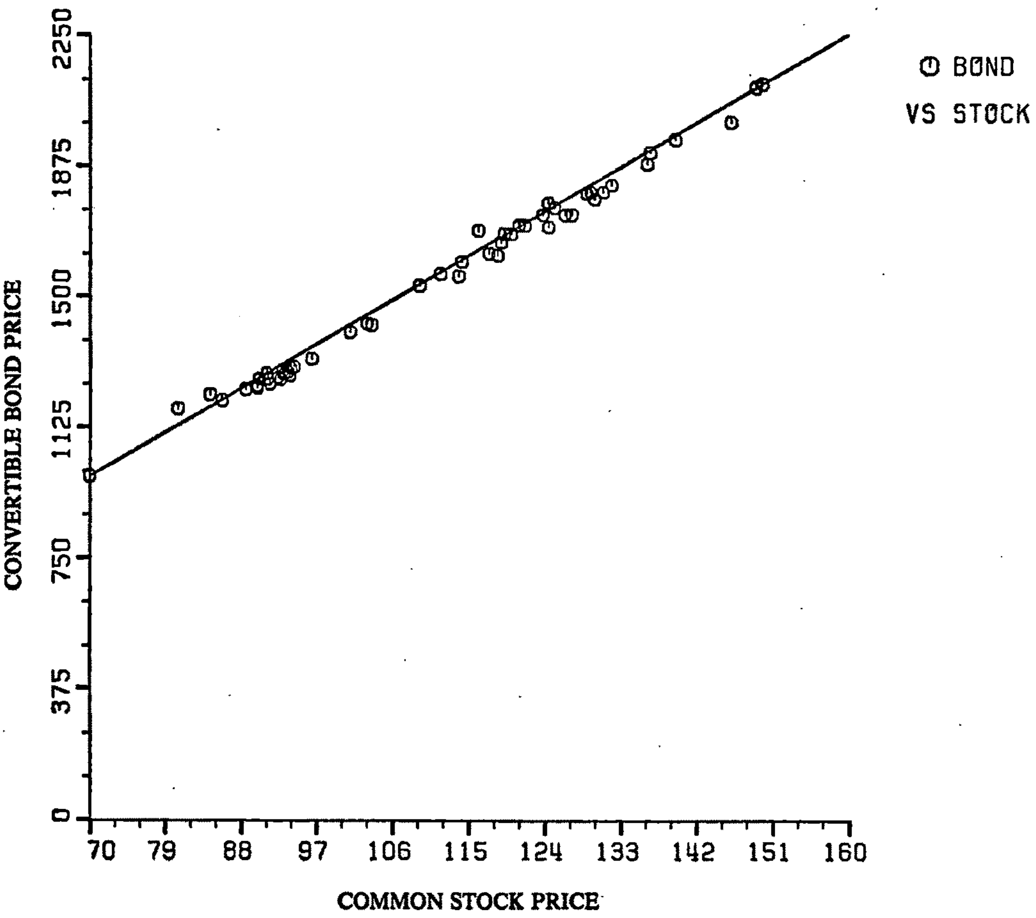
[19] Interestingly, the rule they finally adopted is subject to this same criticism.

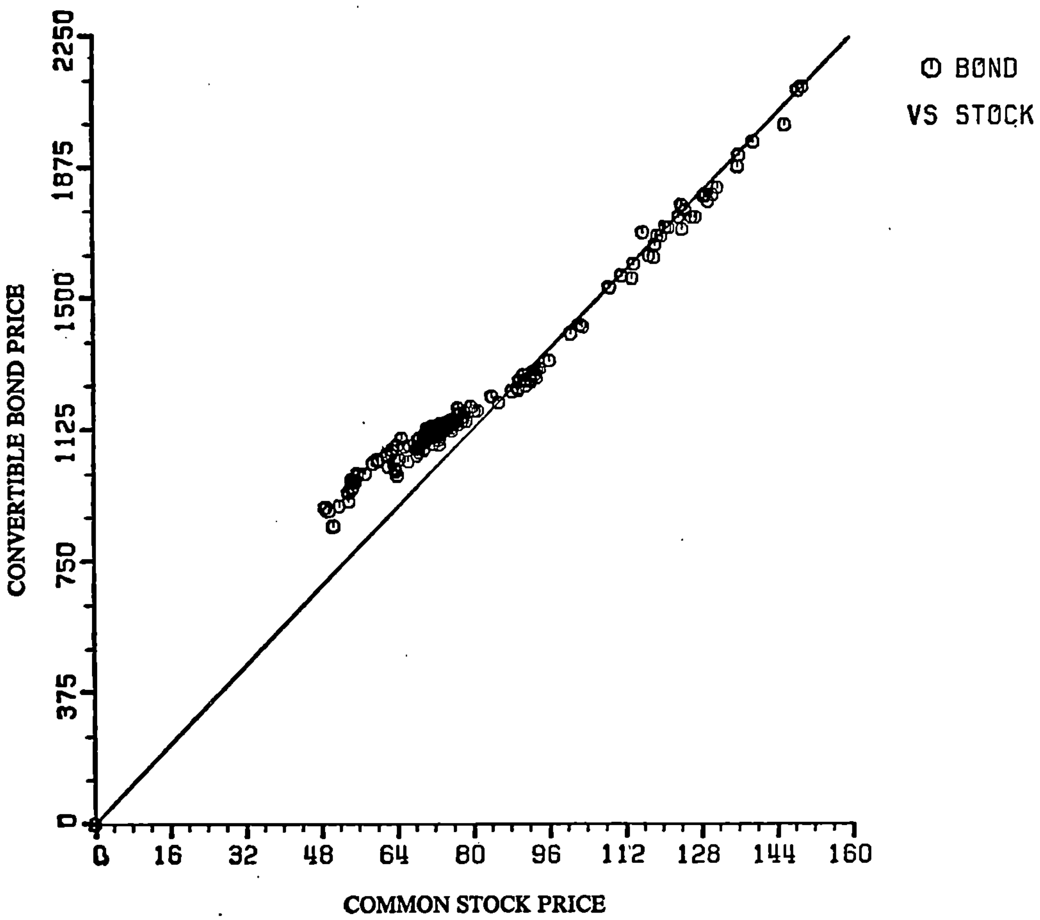
FIGURE 7
CONVERTIBLE BOND PRICE VERSUS COMMON STOCK PRICE
CELANESE CORPORATION
1985



value by some percentage. Two hundred percent was suggested by the APB [AICPA, 1969, paragraph 79]. While this approach also works with market values, it appears fairly sensitive to the selection of cutoff values. There is little assurance that a fixed percentage would likely identify convertible bonds subject to different conditions (e.g., risk) which trade in region C of Figure 1.

The ability to predict conversion has also been advanced by Frank and Weygandt [1971], Arnold and Humann [1973], and Vigeland [1982] as a basis for selecting rules to identify common stock equivalents. If it were known with certainty whether (and when) convertible bonds would be converted into common stock, then this might be the ultimate test for classifying common stock equivalents. However, given the state of the technology, this view represents an attempt to project the future behavior of capital market participants, an endeavor

FIGURE 8
CONVERTIBLE BOND PRICE VERSUS COMMON STOCK PRICE
CELANESE CORPORATION
1983–1985



for which accountants have little comparative advantage. Forecasts of this type fall more within the realm of financial analysis and prognostication than financial reporting.[20]

Even if conversion is accepted as the ultimate criterion, the market test is appealing. Brennan and Schwartz [1977] and Ingersoll [1977a] provide analyses identifying the circumstances under which rational investors will convert bonds to common stock. It is clear that investors will not convert if the converted value of their bond is substantially less than its current market price. Thus, conversion is only likely to be observed when the bond is trading near the converted value line. On the other hand, trading near the converted value line does not imply that conversion is imminent. Hence, trading near the converted value line is a necessary, but not sufficient, condition for conversion.

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[20] One recent study [King, 1984] suggests computing earnings per share based on an allocation procedure. In this method, the market value of convertible debt is divided into debt and equity components (pp. 422–423). However, this method would apparently allocate only a portion of the convertible bond value to equity when it trades along its converted value line. It seems that the entire amount should be equity value.

SUMMARY

This paper suggests an alternative to the APB/FASB's rules for classifying convertible bonds as common stock equivalents. The basic criterion advanced is that a convertible bond is a common stock equivalent if and only if it is priced in the market essentially as though it were a common stock. It can be implemented by applying t-tests to the coefficients derived from a regression of the convertible bond's market value on the underlying common stock price. For a random sample of convertible bonds traded on the New York or American Exchanges, little correspondence was found between bonds classified as common stock equivalents by the market test and by the current rules governing accounting practice.

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BOOK REVIEWS

Richard P. Brief, Editor

Editor's Note: Books for review should be sent to Professor Richard P. Brief, 520 Tisch Hall, College of Business and Public Administration, New York University, New York, NY 10003.

LEONARD J. BROOKS, JR., *Canadian Corporate Social Performance* (Hamilton, Ontario: The Society of Management Accountants of Canada, 1986, pp. xii, 267, Can. $15 nonmembers, Can. $11.25 members).

This is the second monograph on social accounting initiated by the Accounting Principles and Practices Committee of the Society of Management Accountants of Canada. It focuses on the measurement of corporate social performance for management and external reporting purposes. The monograph should be useful to academics and managers interested in this topic for two reasons. First, the monograph provides a convenient summary of measurement and management techniques suggested in the literature and an overview of the current state of the art in large Canadian companies. Second, the extensive appendices after each chapter of documents, lists, and compilations of measures provide a useful resource.

The monograph has ten chapters. The first presents the author's arguments about why a scorecard for corporate social performance is needed. Chapter 2 addresses important issues and developments in the area of corporate social performance, but the main part is devoted to advancing the author's contentions that the health of society and corporations are interdependent and that social performance can contribute to short- and long-term profits. However, only a very limited set of the literature in this area is reviewed and the discussion is shallow.

Chapter 3 takes up measurement and disclosure issues and reviews several methods of reporting ranging from a type of "one-time" inventory reporting to the inclusion of social performance information as an integral part of traditional corporate reporting. The issues associated with the use of descriptive and numerical indicators, expenditure analysis, cost-benefit analysis, and utility analysis are adequately covered. Together with the appendices which set out lists and compilations of measures from other sources, this chapter is a useful summary of measurement and disclosure issues as they relate to corporate social performance.

The next two chapters present the results of two surveys the author undertook among large, publicly traded Canadian companies in 1981 and in 1983 to develop a social performance reporting profile of Canada's largest corporations. The second survey was designed as a follow-up to the first and gathered further information on how social performance is actually managed within companies. The results, which show trends from 1975 to 1980, are compared to known corporate social performance measurement and reporting practices in large U.S. companies.

Chapter 6 provides some interesting information on the development of social objectives and corporate codes of conduct and has a worthwhile set of appendices, which include the Canadian government-sponsored code of conduct for companies doing business in South Africa and extracts from IBM's wide-ranging code of conduct. This is followed by an attempt to gather up the threads of preceding chapters by setting forth a "how-to" model for the management of corporate social performance.

Chapter 8 reviews developments in corporate social performance and its disclosure outside Canada and their implications for Canada. This worthwhile discussion contrasts developments in worker participation in management on the European continent and the institutionalization of social reporting to workers' councils in France to events in the U.S.A. and Canada.

The final chapters discuss a number of ideas and suggestions directed at improving internal and external social performance disclosure and summarize the major findings of the study. Future developments in corporate social performance also are considered.

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JOHN E. BUTTERWORTH and HAIM FALK, *Financial Reporting—Theory and Application to the Oil and Gas Industry in Canada* (Hamilton, Ontario: The Society of Management Accountants in Canada, 1986, pp. viii, 250, Can. $15.00 nonmembers, Can. $11.75 members).

John Butterworth's premature death in 1984 was a sad loss for the accounting profession and, in particular, for many of us who had come to rely on him for his insights on issues concerning disclosure and performance evaluation issues. This excellent book serves as a summary of many of his ideas and of work by Haim Falk.

Actually, the title of the book is a bit misleading. One's first impression is that the book is mainly about oil and gas accounting, but a more appropriate title would have been "A Contractual Model of Accounting Disclosure and Accounting Choice—Theory and an Application." The main contribution is to summarize and critically evaluate the various research paradigms dealing with accounting disclosure and choice issues, and to present an economic model of agency costs to explain these phenomena. The authors call their model the "contractual paradigm of accounting." In addition, the book documents the disclosure and choice issues related to the Canadian oil and gas industry. However, rather than merely examining the industry characteristics, the empirical analysis lends support to the propositions underlying the theoretical model.

Chapter 2 briefly critiques various research methods that have been used to explain accounting valuation and choice. The authors conclude that the stewardship paradigm merely codifies observed practice and hence does not provide theoretically defensible implications for the choice of accounting methods. They also conclude that the capital market paradigm does not appear to suggest anything relevant to accounting choice except that data to help forecast cash flow components should be reported. These conclusions seem harsh, and are not fully supported by arguments in the chapters. The discussion, however, does not claim to be complete with respect to these arguments. Moreover, I liked the direct and unambiguous writing style which is a welcome contrast to the overly cautious and neutral tone ("it is not clear," etc.) one often sees in journal articles.

Generally, the authors seem more positive toward the agency cost formulation of Jensen and Meckling and others, but they note that current empirical work in this area is mainly inductive in nature and lacks an economic foundation. Analytical models of agency relationships are also criticized as incomplete. The authors note that these models generally hinge on the critical but unrealistic assumption that managers have a negative utility for personal effort (time, etc.). On the one hand, effort is not a "major criterion in management decision situations." Strategic decisions facing firms are not necessarily better resolved by spending more time in the office. On the other hand, successful executives tend anyway to be workaholics. (A recent survey found that 60 percent of CEOs work more than 60 hours a week and only three percent work less than 50 hours a week.)

The alternative model of financial reporting offered by the authors is termed "contractual paradigm." The model, developed in Chapter 9 (which logically should have been placed after Chapter 2), is based on the proposition that "the primary purpose of a reported earnings number is to provide [agents] an efficient basis for mutual contracts." It is clear that the underlying theme of this model is the same as the agency cost model of Jensen-Meckling. However, the authors contend that whereas the Jensen-Meckling approach is descriptive and inductive, their approach is based on a well-specified partial equilibrium model of the firm. Depending on a reader's prior exposure to the analytical agency cost literature, the model may or may not provide new insights on the contractual constraints facing a firm. In any case, it provides an excellent example of the model structure needed to address contractual issues.

The remaining chapters (3 to 8) present the research design and findings of the empirical study based on a sample of 219 oil and gas firms. The objective of the analysis is to document the extent of voluntary compliance with a Canadian disclosure rule for oil and gas firms. The contracting model "suggests that, subject to cost constraints, managers will be motivated to disclose more information rather than less," since this leads to more efficient contracting. The empirical analysis is intended to examine this issue. If more than minimum voluntary disclosure is observed, then "this may suggest that disclosure rule making may not be necessary, and that funds spent on such rule making may be utilized more effectively." Using a non-parametric technique called scalogram, the authors find that for about 40 percent of the disclosure items, "a materially higher level of aggregation" (i.e., less detailed disclosure) than recommended was found. However, a materially lower level of aggregation was found for an equal number of disclosure items. In general, Butterworth and Falk conclude that the results on disclosure and on accounting choice (full cost and successful efforts) support their contracting paradigm.

The book can be viewed as two books in one—one presenting the theoretical model and the other presenting the empirical findings. While each segment is effective, more effort in integrating the two parts would have been useful. Also, the authors do not convincingly explain how their proposed "paradigm" differs from existing analytical models of agency costs that focus on contracts.

The book is well-produced except for one minor editorial error—the appendices to Chapter 9 have been mislabeled as A and B instead of 9.1 and 9.2, resulting in a bit of confusion since they are also followed by two appendices to the book that are labeled A and B. Furthermore, the scalogram technique, while effective as a statistical tool, does not appear to produce visually informative graphs. Finally, this reader felt that the type font was too small and hence hard on the eyes. The book also lacks an index.

These are minor shortcomings. Overall, the book should be useful reading to anyone interested in analytical agency cost models or to researchers needing a review of various research methods dealing with accounting choice.

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ALLEN CRASWELL, *Audit Qualifications in Australia 1950 to 1979*, Accounting Thought and Practice Through the Years series (New York and London: Garland Publishing, Inc., 1986, pp. x, 169, $22.00).

This is a descriptive work which provides a historical overview of the evolution of auditor responsibility in Australia with regard to qualified audit reports. Craswell accomplishes this by chronicling changes in the *Companies Act*, legal cases, and the evolution of accounting standards over a 30-year period. The central question of the study is why audit reports (i.e., opinions) were qualified by auditors in Australia between 1950 and 1980. In his words, "the essence of the approach adopted . . . is to review the legal and professional obligations facing auditors, to interpret those obligations in terms of their potential effects and to test for significant changes in the frequency of audit qualifications" (pp. 2–3).

Qualifications are defined as "statements in audit reports referring to non-compliance with accounting standards . . . , to problems in the valuation or measurement of financial statement items . . . , and to non-compliance with provisions of the Companies Act" (p. 28). Throughout the study, it is assumed that auditors qualify an opinion in order to avoid sanctions or penalties. No assumptions are made with regard to the behavior of management, nor is such behavior specifically modeled in the analysis.

Craswell examines a total of 33,522 annual reports relating to companies that were listed on the Sydney Stock Exchange between the years 1950 and 1979, of which 2,740 were qualified. These 2,740 reports comprised the sample for the study. The hypothesis investigated was that "auditors respond to changes in their legal and professional obligations and to the extent that those changes impinge upon reporting obligations, changes in the frequency of qualifications can be expected to result" (p. 16). The qualified reports were sequentially classified, first on the basis of whether the firm was listed on the industrial or mining board of the Sydney Stock Exchange and then on the nature of the specific qualification made in each report. Qualifications were classified into three categories: statutory, where some provision(s) of the *Companies Act* had been breached; technical, where the statements violated accounting standards; and uncertainty, where there were unknown outcomes or contingencies. Graphs provided in chapter four of the study easily convince the reader that there was a significant change in the percentage of opinions qualified after 1971. However, the remainder of the study, while thorough in its discussion of the possible reasons for the observed change, does not provide tests of significance or isolation of specific causes to the exclusion of other possible factors.

Chapters five, six, and seven give a concise historical overview of the evolution of the current climate and state of auditor responsibility from three points of view: (1) changes in the

Companies Act, (2) the development of common law regarding contractual obligations, and (3) the evolution of accounting standards from 1950 to the present. Each provides a plausible explanation for the dramatic change in qualified opinions after 1971. However, the hypothesis set forth in chapter two was not tested. Although discussion to support the hypothesis is presented in each of the chapters, there are very few statistical tests. As a result, competing hypotheses were not ruled out. However, given the simultaneous nature of the changes identified by Craswell in the *Companies Act*, common law, and accounting standards, construction of tests to distinguish among these three potential sources of qualifications would be extremely difficult.

Overall, Craswell has provided a well-written, concise, and thoughtful presentation of the changes in the legal and professional environment in Australia from 1950 to 1980. But due to the lack of tests of implicit competing hypotheses and the difficulty of constructing tests to differentiate among the factors identified in the study, the conclusions are not easily interpreted. Also, some indication of the benefits from determining why reports have been qualified (such as information content for financial statement users) would help to assess the arguments and reasoning set forth in chapters five through seven. Despite these limitations, this work would make good reading for anyone interested in comparative national studies of accounting topics and individuals with interests in international aspects of auditing and legal liability.

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Thomas G. Evans and Timothy S. Doupnik, *Foreign Exchange Risk Management under Statement 52, A Research Report* (Stamford, CT: Financial Accounting Standards Board, 1986, pp. ix, 133, paper, $16.00-students, $20.00-others).

Thomas G. Evans and Timothy S. Doupnik, *Determining the Functional Currency under Statement 52, A Research Report* (Stamford, CT: Financial Accounting Standards Board, 1986, pp. ix, 92, paper, $16.00-students, $20.00-others).

Given the controversy over accounting standards in the area of foreign currency translation, and the FASB's remarkable change in views when it issued *SFAS 52* to replace *SFAS 8*, I was pleased to learn that the Board had commissioned the above *Research Reports* to assess how companies were adapting to the financial reporting environment under *SFAS 52*. While I shall concentrate on the study dealing with foreign exchange risk management (hereafter FERM) in this review, I also offer some commentary on the functional currency study (hereafter DEFC).

The FERM study sought to evaluate at least some of the economic consequences of *SFAS 52* by identifying linkages between changes in companies' FERM practices and the new financial reporting environment created by *SFAS 52*. One hundred and sixty-seven firms completed the 22-page questionnaire (31 percent response rate). In addition to using descriptive statistics to report the responses, the authors used a cross-tabulation procedure to test for statistically significant relationships between the answers of subgroups of respondents to a number of the questions in the study. For example, *remeasurement* exposure is hedged by a much higher percentage of the firms that hedge *translation* exposure, compared to the firms that do *not* hedge translation exposure.

This brings me to the one concern I have with the FERM study. In my judgment, useful results will be obtained only if (1) respondents have significant foreign operations and (2) adequate distinction is made between what changed in *SFAS 52—translation* under the current rate method for certain foreign entities—and what did *not* change—translation (technically, *remeasurement*) using the temporal method of *SFAS 8* with minor modifications for other foreign entities. I am satisfied as to the first point because more than 50 percent of the respondents indicated that their foreign operations exceed 20 percent of their total operations. As to the second point, while I am satisfied that the authors clearly understand the translation/remeasurement distinction, I am less certain that all of the respondents appreciated that distinction.

Several times in the study the authors indicated surprise at responses relating to translation and remeasurement issues. For example, respondents reported more hedging activity related to *translation* adjustments than to *remeasurement* adjustments. This result was not expected because translation adjustments have little economic significance and bypass the income statement. Moreover, it was inconsistent with the finding that respondents considered reduction of remeasurement-based losses (which *are* reported in income) more important than reduction of translation-based losses. Because 38 percent of the foreign entities reported by respondents to the

DEFC study used the U.S. dollar as their functional currency, I doubt that the apparent uncertainty over the relative importance of remeasurement adjustments is due to lack of materiality. I fear that the FERM study's ability to assess economic consequences of *SFAS 52* may be impaired by respondents' misunderstandings of the distinction between translation and remeasurement.

Overall, respondents indicated that *SFAS 52* had little impact on the level of change in their companies' FERM practices. Concern over managing economic exposure and the changing international environment—factors other than *SFAS 52*—seem to be the dominant forces driving companies' FERM activities. The percentage of firms believing that exchange rate risk is a *serious* problem has declined to about 50 percent in the present study from about 75 percent shortly after *SFAS 8* was issued. While the ability to keep translation adjustments off the income statement with *SFAS 52*'s current rate method has probably contributed to this perception, companies have undoubtedly moved down the FERM learning curve since the late 1970s.

Turning now to the DEFC study, 180 firms completed the 18-page questionnaire for a 35 percent response rate. As in the FERM study, descriptive statistics and cross-tabulations were used to analyze the data. Under *SFAS 52*, the translation/remeasurement method and treatment of the translation adjustment for a given foreign entity follow directly from determination of the entity's *functional currency*—the currency of the principal economic environment in which the entity operates and generates net cash flows. Because the difference in accounting is ostensibly to reflect different economic circumstances, it would be helpful to know whether the functional currency selection process adequately discriminates between substantively different foreign entities.

Respondents said they used the six salient economic factors provided as guidance in *SFAS 52*, citing cash flow and revenue and expense aspects of their foreign operations as the most important indicators of the appropriate functional currency. The authors concluded that the selection process did distinguish entities which are self-contained foreign operations from those which are mere extensions of their parent companies. Interestingly, 40 companies reported that their external auditors did not review their functional currency determinations. For the other 140 firms, the external auditors challenged 27 of their functional currency selections but prevailed in only one of those 27 cases.

There is a wealth of information in these two studies. Despite my concern with the FERM study, the FASB, the authors, and the respondents should be commended for contributing to this important follow-up research.

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JILL MCKINNON, *The Historical Development and Operational Form of Corporate Reporting Regulation in Japan* (New York: Garland Publishing, 1986, pp. 453, $50.00).

This book is an important addition to the international accounting literature. It examines the contemporary system of regulating corporate financial reporting in Japan, analyzing both the historical development of the system and the environmental influences on it. The book focuses on how accounting standards are formulated and regulated in Japan, not on the standards themselves.

There are recurring calls in the international accounting literature for a greater understanding of the rationale underlying accounting requirements in specific countries to better understand why differences in accounting requirements exist across countries. Nation-specific research such as this book contributes toward that end. Despite Japan's economic importance in the world, there is relatively little in the English-language literature on Japanese accounting. This book is a publication of McKinnon's Ph.D. dissertation (1984) and it is arguably the most comprehensive English-language study available of the Japanese system of corporate accounting regulation. Those interested in comparative international accounting as well as accounting regulation should find this book worthwhile reading.

The research method used is new to the international accounting literature and should be considered for other nation-specific studies conducted in the future. It provides a structure for interpreting the development of a reporting system which also incorporates social and cultural factors. As a result, the study is more than just a description of the existing system of accounting regulation in Japan. The research method, adapted from the social systems literature, focuses on the changes that have occurred in the Japanese system of accounting regulation. It begins by identifying so-called "central response events"—events that mark the major changes in the system. These events are then used to direct an analysis of why the changes occurred and their eventual effects.

The political, legal, and corporate elements in Japan are viewed as separate, co-existing systems which interact with each other as well as with the system of accounting regulation. All of the systems are influenced by the social and cultural environment. Data used for both identifying central response events and the subsequent analysis consist of an examination of relevant literature and personal interviews.

The book is organized into 11 chapters and eight appendices. Chapter 1 is introductory, chapter 2 is a literature review, and chapter 3 describes the research method. Chapter 4 examines the contemporary Japanese system of accounting regulation and identifies the five central response events which provide the focal points for the subsequent analysis in chapters 6 through 10. Chapter 5 describes both the social environment and the political, legal, and corporate systems in Japan. Chapters 6 through 10 represent the heart of the book, each analyzing one of the five significant changes that have occurred in the Japanese system of corporate reporting regulation. Chapter 11 provides the conclusions and implications of the study. Included in the appendices are the transcripts of the interviews conducted for the study.

There are two criticisms of the book.

1. The author does not explain very well how she determined the central response events after reviewing the literature and conducting her interviews. Researchers who wish to use her framework would have found such a description helpful.
2. The author does not indicate whether she confined her literature search to that written in the English language. If so, it is unclear whether this in any way biases her findings.

The book amply demonstrates the complexity of Japan's system of accounting regulation as well as the pervasive effect that the Japanese social and cultural environment has had in its development. This comprehensive analysis is its major contribution to the international accounting literature. A second important contribution is the potential usefulness of its research method for nation-specific accounting studies conducted in the future.

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C. W. NOBES and R. H. PARKER, Editors, *Comparative International Accounting*, Second Edition (Oxford, England: Allan Publishers Limited, and New York: St. Martin's Press, Inc., 1985, pp. xvi, 283, $32.50).

This book is clearly one of the better contributions in the area. It is more informative and thorough in its treatment than most of its competitors.

The stated objective is to provide a textbook for undergraduate and graduate courses in comparative and international accounting, with particular (but not sole) appeal for students from Anglo-Saxon backgrounds. I believe that the editors have provided the most complete textbook treatment of the comparative practices for the eight countries which form the basis of the chapters in Part I—Australia, Canada, France, the Netherlands, the United Kingdom, the United States, and West Germany (which were all covered in the first edition) and Japan (which has been added in this second edition).

Herein lies the problem which I believe this and similar texts face: the choice of countries to be studied. Here the choice has been justified using the frequency of a country's appearance on six lists where the criterion for appearing on each list is based on a particular characteristic. But four of these lists are related to characteristics that measure the "vitality" of the accounting profession. Clearly, there are other logical ways to decide on countries to choose. But, in the end, any such choice is arbitrary, and those interested in studies of countries not included will have to look elsewhere.

There are two other problems, both of which are unavoidable in a text of this kind. First, the chapters are written by different authors and this leads to a differential quality in the style and, more importantly, the content of each topic. In fact, the "best" chapters are the ones written by the editors themselves, who state that they have consciously avoided trying "to force each chapter into a common mould."

The second problem is that the book is, in some respects, obsolete before it is published and this obsolescence becomes more exaggerated over time. The reason is simply that accounting policy-setting is a dynamic process in most of the countries being discussed. One may argue that marginal changes are not important, but there are examples such as changes in accounting for deferred taxation and pensions in the U.S. which are sufficient to change the significance of the analysis. This problem can be overcome by having the text published in a binder format with frequent updates. If this is not feasible, then a less expensive paperback version will make the book more marketable as a classroom text.

The country studies describe the accounting practices and the accounting profession, with a discussion of the differences between the local and Anglo-American practices. The emphasis is placed on trying to explain the differences, particularly in reference to the sociopolitical environment. Given the diversity of authors, the emphasis varies. For example, the chapter on West Germany emphasizes legal dimensions, while the chapter on France strikes a more even balance between legal considerations and actual practices (both are legally based systems).

Part I also includes an excellent chapter on the "International Classification of Financial Reporting," which summarizes and critically evaluates the past research in the area, and a disappointing chapter on "Accounting in Developing Countries." The latter uses dated material, spends too much time discussing broad issues, and only cursorily deals with individual practices in a few developing countries.

Part II of the book deals with "Problem Areas" including:

(1) Consolidation Accounting—a well-written and informative chapter with current information on some countries (e.g., France) but not others (e.g., U.S.).
(2) Inflation Accounting—a chapter with comprehensive coverage of many countries' current practices, in which the author makes the common error of assuming that SFAS 82 excludes all Price Level Accounting adjustments.
(3) Foreign Currency Translation—an interesting chapter spoiled by the constant invocation of the author's personal biases and another common error of assuming that the use of current cost accounting will prevent translation problems from arising.
(4) Foreign Exchange Risk Management—a good addition in the second edition, although the author needs to be more specific in treating some of the issues.

Part III of the book has two chapters dealing with the harmonization of financial reporting and of taxation. The former has an excellent treatment of the institutional factors affecting harmonization, but more discussion of the impact of economic factors, in particular the globalization of capital markets, is needed. The tax chapter is good, but naturally is going to become quickly out of date.

In summary, this book is an essential addition to the library of anyone interested in international accounting. However, I believe its classroom appeal will be limited by the fact that it is too expensive in its cloth version to warrant adoption in most international accounting courses, especially given the number of countries covered in depth, and the potential for the obsolescence of the information.

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KENNETH W. STRINGER and TREVOR R. STEWART, *Statistical Techniques for Analytical Review in Auditing* (New York; Chichester, England; Brisbane; Toronto and Singapore: A Ronald Press Publication, John Wiley & Sons, 1986, pp. xii, 301, $42.50).

This book explains the Deloitte Haskins & Sells (DH&S) regression approach to analytical review of particular account balances. The STAR Program (an acronym for statistical techniques for analytical review) is a stepwise linear regression package used to assess the validity of book balances in both cross-sectional and time-series studies. An integral part of the STAR Program is an audit interface that adapts the general regression model to particular application in analytical review. The book is a straightforward description of the STAR Program with little discussion of or comparison to other competing approaches to analytical review. It will be of interest to practicing auditors and academic researchers wishing to understand the DH&S philosophy of and approach to analytical review. Because of its limited scope, its use in advanced auditing courses is limited to a supplemental role.

The book consists of four basic parts. Part I (two chapters), The Audit Environment, highlights auditing standards and processes that relate to the application of regression analysis in analytical review. It contains an interesting discussion of the role of statistical techniques in the audit process and their relationship to audit judgment. Part I describes the five steps involved in an application of the STAR Program and presents the computer output from a simple application of the program. The remainder of the book discusses the steps and the statistical theory that underlies their implementation. The five steps are: (1) designing the audit model, (2) running the STAR Program, (3) reviewing the Program printouts, (4) investigating unusual fluctuations, and (5) evaluating audit results.

Part II (chapters 3, 4, and 5) is a basic development of regression analysis. The simple two-variable model is developed in chapter 3 and multivariate models are discussed in chapter 4. My general impression is that anyone familiar with regression analysis will find nothing new in these chapters and that anyone who has never been exposed to regression analysis will find these chapters to be too sketchy to really master the technique. The chapters are best suited to those readers who have been previously exposed to statistical techniques, have been away from them for a while, and now need to be refreshed.

STAR uses regression analysis to estimate a linear relationship between audited values and appropriately selected independent variables. Chapter 5 explains the statistical logic used to determine which residuals, differences between recorded amounts, and estimates projected from the regression model should be investigated. Again, no comparison is made between the STAR approach to determining excess residuals and competing approaches.

Part III of this book (chapters 6 and 7) deals more directly with problems of auditing rather than statistics. Chapter 6 discusses the audit objectives to be met and the appropriate design of statistical models for analytical review. The selection of dependent and independent variables, statistical precision and reliability, numbers of observations in the data profile, errors in variables, and data points which are outliers are among the topics explained in this chapter which concludes with a summary of the principal characteristics of regression models in over 9,000 actual STAR applications.

Chapter.7 walks the reader through an application of the STAR program after the model has been specified and the data collected. Causes of excesses in need of investigation are enumerated and the general process of searching for analytical explanations of excesses or expanding tests of details are described.

Part IV of the book (chapters 8 and 9) is a more rigorous development of multivariate regression than presented in Part II. No new auditing insights are developed in this part of the book. Those readers who are statistically sophisticated may omit Part II and read Part IV instead, while those readers primarily interested in learning about STAR applications may skip Part IV altogether.

While the book is intended to be a development and discussion of the STAR program, the DH&S formal statistical approach to analytical review, it fell short of being as valuable as it could have been for two reasons. Chapters 5, 6, and 7, the non-statistical chapters of the book, failed to convey the "art" involved in model development and interpretation. These chapters were too terse and clinical and explained STAR applications in a detached manner, so that readers wouldn't really know where to start if they were doing an application on their own. The book also missed a great opportunity to compare the STAR approach to other statistical approaches to analytical review, and therefore missed its chance to be a much more valuable reference tool for auditors and auditing researchers. Nonetheless, this book should be essential reading for anyone attempting a STAR application.

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Daniel B. Thornton and Murray J. Bryant, *GAAP (Generally Accepted Accounting Principles) vs. TAP (Tailored Accounting Principles) in Lending Agreements: Canadian Evidence*, Studies in Canadian Accounting Research (Toronto: The Canadian Academic Accounting Association, 1986, pp. 775, Can. $10 paper).

This research monograph explores whether Canadian public debt covenants utilize covenant-specific tailored accounting principles (TAP) as opposed to generally accepted accounting principles (GAAP) to enforce covenant restrictions. Much of the research on the positive theory of accounting has claimed that the desire to loosen covenant constraints is a motivation for many accounting choices. However, if most debt covenants actually use tailored covenant-specific accounting, then the GAAP reporting choices would not have the ability to loosen covenant constraints. Thus, a study of the content of covenants is needed to confirm that accounting choices actually do matter.

This monograph consists of five chapters and an appendix. The first two chapters and the appendix provide an excellent background to debt contracting and bond covenants. The authors explain that previous research is boilerplate-oriented and does not allow empirical conclusions about the specifics of debt covenants. Their last three chapters describe a data sample, a set of hypotheses, and results of empirical tests of the hypotheses.

The authors use a sample of 71 covenants written by sundry lenders for Canadian lessees in the 1974 to 1981 period. Classification of covenants as TAP- or GAAP-oriented is based on how the covenants deal with lease accounting. In all, 34 of the covenants use TAP- and 37 use GAAP-oriented lease accounting. The TAP versus GAAP classification is used as a dependent variable in a probit test while firm and covenant characteristics are the independent variables.

The firm-specific variables include size of the borrower, industry of the debtor, change in the net tangible asset ratio, volatility of debt measures, materiality of the new debt, and interest coverage at the time of issue. The covenant-specific measures include the life of the lending agreement, the convertibility of the issue, the required security, and whether the covenant applies to debt or a preferred stock. The authors hypothesize differences in TAP versus GAAP choices based on differences in the firm-specific and covenant-specific variables.

Generally, the authors hypothesize that covenants or firms with greater risk due to longer life, greater relative debt, less security, etc. are more likely to use TAP as opposed to GAAP. *Ceteris paribus*, lenders incur the cost of using TAP only when greater default risk justifies the extra costs. Empirical results indicate that these independent variables do assume hypothesized directions.

Nonetheless, the authors' empirical results are subject to skepticism. First of all, covenants' treatment of lease accounting is a very narrow basis to classify covenants as GAAP- or TAP-oriented. The Leftwich paper in the January 1983 issue of THE ACCOUNTING REVIEW illustrated that variations in accounting treatment in covenants extend to many areas in addition to lease accounting. The authors' classification of covenants only on the basis of lease accounting ignores substantial relevant data.

Also, the sample of covenants may not provide an ideal basis for generalization. More than half of the authors' sample of 34 TAP-based covenants are from three debtors, and six debtors represent more than 75 percent of the TAP group. Moreover, the TAP group is dominated by utilities. It is not clear that the sample is representative of the population of bond covenants. As a result, implications of the empirical results are unclear.

By and large, this book should be valuable to researchers interested in positive theory or the nature of debt restrictions. The background material on debt covenants is very informative and the monograph's empirical testing of the nature of covenants is needed in the positive accounting literature. However, limitations in the monograph's covenant classification scheme and sample problems assure that additional research is needed.

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WALLACE EARL WALKER, *Changing Organizational Culture: Strategy, Structure and Professionalism in the U.S. General Accounting Office* (Knoxville, TN: The University of Tennessee Press, 1986, pp. xvii, 202, $19.95).

This volume represents another interesting contribution to the accounting literature by a professor of political science. However, the exact nature of that contribution will vary with the interests the reader brings with him/her. As the author recognizes in his preface, the book is of interest to a wide variety of readers. One is the accountant who is concerned with the evolution of the General Accounting Office over the period 1940 to 1981. A second is the researcher interested in how an organization's culture evolves and may be changed. The latter is of particular interest to the accountant because of the organization studied. Finally, it provides an insight into the fate of accounting information in the political arena.

This reviewer is not an authority on the evolution of the General Accounting Office (GAO). However, it was an important period when the function of the GAO shifted from the vouching of expenditures to performance auditing and evaluation. Walker's discussion of this period has a ring of authenticity and is consistent with the general impression one forms of the GAO. Walker's discussion blends insights acquired in equal parts from public records and from anonymous personal interviews with past and present GAO employees. Even one who disagrees with his reading of the record he has assembled will find this history a worthy effort against which to measure one's conflicting point of view.

Congress' need for both evaluation and oversight in dealing with branches of the executive required the GAO to accept these new responsibilities. However, the author believes that this need created the opportunity to which the directors responded. Warren changed the GAO from the controller of expenditures—which it no longer could be because of the growth in the size of government—to an overseer. In the process, he introduced the professionalism of the CPA auditor. Campbell, the next in line, refined the professional attitude and brought the organization's culture even closer to the myths and values of the CPA. One of the results of the professionalization of the GAO under Warren and Campbell, according to Walker, was the negative perception of the GAO by its critics. This he attributes to the auditor's adopting of the CPA's fault-finding orientation. Staats, the third major figure to head the GAO during this period, expanded the professional staff to include behavioral scientists in top positions. He thereby changed the GAO's culture to include the interdisciplinary skills and values we now associate with the organization and reduced the image of the GAO as primarily interested in fault-finding. Viewed through Walker's reconstruction of events, these themes appear credible.

It is not until the volume's penultimate chapter that Walker reflects on what he perceives to be the actual impact of the GAO. Here he develops what the reader may find to be a surprising conclusion: the impact of the GAO has been severely limited relative to the goals and aspirations its directors set for it. The political interests of the various groups and individuals in Congress have determined which reports are seized upon and pursued by Congress and which are left to flounder. The message is clear. All of the efforts that went into providing the best possible oversight are at risk unless their results have an audience that is receptive to them and ready to support them with political clout! It is a message that should not be ignored by the reader.

While the book is generally easy to read and follow despite the scope of the topic, it would have benefited from a discussion in chapter one of what factors the author sees as the components of an organization's culture. Myths, norms, and values all appear to play a part in Walker's view of that particularly elusive concept. How they play a part is left to the readers to evolve for themselves. Since culture currently is a popular term and the study raises interesting questions in that area, a road map presented at the outset would have helped.

Overall, the book is one that will offer readers a good return on their efforts. It may even initiate a line of research into the role of culture in other organizations where accountants predominate. If so, the results could be interesting social documents.

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SHARI H. WESCOTT and ROBERT E. SEILER, *Women in the Accounting Profession* (New York: Markus Wiener Publishing Company, 1986, pp. 238, $11.95 paper, $24.95 cloth).

The authors' stated purpose is "to provide a documentation of the historical, sociological, and cultural background of the opening of this (the accounting profession) to women." By accounting profession, the authors mean public accounting, as this book does not discuss other career paths in accounting. They note in the foreword that their emphasis is on areas in which women continue to encounter difficulty in obtaining true equity and that they take the woman's point of view.

This easy-to-read and interesting publication is not based on a scientifically developed research plan. The authors state that the information used as a basis of the book was gathered largely through "interviews with hundreds of women, including practitioners, students and business persons." Men were also interviewed because "their views, biases, and perspectives were of interest in our documentation of how the profession opened itself to women."

The reader is not provided with any additional information concerning the persons interviewed. No attempt was made to gather information and report results from these interviewees on a particular question or issue. Instead, the input of the women interviewed is captured with selected quotes throughout the book.

This book will be of primary interest to those considering or preparing themselves for careers in public accounting. Several chapters have as much relevance to men as to women, specifically chapters 5–8. These chapters discuss topics such as recruitment practices, training programs, the work of various levels of personnel in a public accounting firm, how partners are selected, and differences between large multinational firms and local firms. The information that specifically describes the responsibilities at various levels in a public accounting firm and what admission to partnership means is especially interesting, as such data are not often conveyed to those considering or preparing for careers in public accounting.

The book's orientation is one of describing problems a woman may encounter and which may inhibit her professional progress. There is little advice or information offered on how these problems are being solved. For example, the authors note the stresses that develop for women who are trying to combine marriage and child-rearing with public accounting careers. However, they give no insights into policies and programs that exist in public accounting relevant to these issues, nor do they describe how the women interviewed are coping.

The most interesting parts of the book to this reviewer were those which chronicle the history of women's entrance into the profession. Chapter 1, for example, gives statistics on the number of women in the profession over time, and chapter 3 describes the resistance women encountered in becoming a part of the profession prior to the late 1960s. The founding and development of the American Women's Society of CPA's and the American Society of Women Accountants is discussed in a later chapter.

The book concludes with a chapter describing the number and status of women public accountants in other countries.

Women in the Accounting Profession can be recommended to any woman considering or preparing for a career in public accounting. Most women who are members of the profession or who teach accounting will find the chapters related to the history of women in the profession of interest. Women looking for statistically-described information on the status of women in the profession and their attitudes toward the profession will not find it in this publication.

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THE ACCOUNTING REVIEW
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NEW BOOKS: AN ANNOTATED LISTING

Editor's Note: As a general policy, books received but not reviewed in this or future issues will be annotated. There will be some exceptions.

Accounting and Financial Reporting by Agricultural Producers: A Research Study (Toronto: The Canadian Institute of Chartered Accountants, 1986, pp. 132, Can. $25.00 paper).

Study considers how "generally accepted accounting principles" should be applied to agricultural producers and which current conventions are unique to agriculture and should be endorsed. Also provides guidance on financial reporting, valuation policies, and techniques to assist in resolving farm accounting problems. The monograph was prepared by a study group of The Canadian Institute of Chartered Accountants.

JOAN LORDI AMBLE and JULES M. CASSEL, *A Guide to Implementation of Statement 87 on Employers' Accounting for Pensions: Questions and Answers*, Special Report (Stamford, CT: Financial Accounting Standards Board, 1986, pp. vii, 106, $12.00 paper–academic or member, $15.00 paper–other).

The questions and answers in this Special Report are organized by the paragraphs in Statement 87, *Employers' Accounting for Pensions*, to which the questions relate. Illustrations supplement the answers. A topical index and cross-references by Statement 87 paragraph number also are included to assist the reader in locating an FASB staff position on a particular issue or FASB staff answers relating to a specific paragraph. The full text of the standards section of Statement 87 is reprinted in an appendix. Joan Lordi Amble is Project Manager and Jules Cassel is Senior Technical Advisor of the FASB.

IRVING L. BLACKMAN, *The Valuation of Privately-Held Businesses: State-of-the-Art Techniques for Buyers, Sellers, and Their Advisors* (Chicago: Probus Publishing Company, 1986, pp. viii, 400, $47.50).

Sixteen chapters cover valuation of a business for specific purposes. Surveys major approaches to valuation and addresses specific valuation problems relating to intangibles, recapitalizations, preferred stock, ESOPs, redemptions, gifts, and charitable contributions. Five appendices illustrate different valuation methods and discuss IRS rulings, court cases, valuation ratios, and unified gift and estate tax rates for 1988 and after. Irving Blackman is a founding partner of Blackman Kallick Bartelstein, a CPA firm.

HENRI BOUQUIN, *Le Contrôle de Gestion, Contrôle de Gestion, Contrôle d'Entreprise* (Paris: Presses Universitaires de France, 1986, pp. 298, FF145.00 paper).

Book's three parts discuss the control systems and processes of the firm, define a management control structure, and describe the design of a planning and information control system. Methodology links the management control system with key factors of competitiveness and financial equilibrium, classifying them according to different time horizons. Analysis raises two main issues of whether management control systems can be isolated from other aspects of organizational control and whether control mix choice—i.e., the mix of the rules, markets, and culture, which comprises the control systems—can be stated. Henri Bouquin is Professor, Université de Lille I, Cité Scientifique.

Adrian Buckley, *Multinational Finance* (Oxford: Philip Allan Publishers Limited; distributed in the U.S.A. and Canada by Humanities Press, Atlantic Highlands, NJ, 1986, pp. x, 398, $29.95 paper, $70.00 cloth).

Text, designed for M.B.A. and upper-level undergraduate students as well as practitioners, provides an overview of multinational finance. Book is intended to "improve performance and awareness in the currency management area" in the U.K. Topics covered include foreign exchange risk and markets, exposure management, and foreign currency financing. Author uses examination questions of the Association of Corporate Treasurers and Institute of Bankers to divide the chapters of the text. A list of ten books on multinational finance, a glossary, and a present value table are included. Adrian Buckley is Professor of International Financial Management at the Cranfield School of Management and Director of its M.B.A. Program.

D. R. Carmichael and **Martin Benis**, *Auditing Standards and Procedures Manual: 1986–1987* (New York; Chichester, England; Brisbane; Toronto and Singapore: A Ronald Press Company Publication, John Wiley and Sons, 1987, paginated by section, $75.00 paper).

Reference manual follows the sequence of the sections of the AICPA Codification of Auditing Standards, with each section divided into six parts: Effective Date and Applicability, Definitions, Objectives, Fundamental Requirements, Techniques for Application, and Illustrations. This division is designed to assist the auditor in identifying the minimum requirements of an SAS. While written for the independent auditor, the Manual is also suitable for use by auditing instructors. D. R. Carmichael and Martin Benis are Professors of Accounting at Baruch College, The City University of New York.

Jerome B. Cohen, **Sidney M. Robbins**, and **Allen E. Young**, *The Financial Manager* (Columbus, OH: Publishing Horizons, Inc., 1986, pp. xv, 748).

Authors explain the role of the financial manager, examining the effects of theory on practice. The book's first five parts represent a basic text in financial management. Considered are the interrelationship between theory and practice, techniques of financial analysis, management of working capital, management of intermediate and long-term sources of funds, and capital budgeting. Part Six and appendices address special problems of interest to the practitioner and for classroom use at the discretion of the instructor. Jerome B. Cohen is Professor of Finance and Dean (Emeritus) at Bernard M. Baruch College, The City University of New York. Sidney Robbins is Chase Manhattan Professor Emeritus of Financial Institutions at Columbia University. Allan Young is Professor of Finance at Syracuse University.

Christopher J. Cowton, *A Study of the Disclosure of Charitable Donations by Companies in the United Kingdom*, Research Paper (London: The Institute of Chartered Accountants in England and Wales, 1986, pp. ii, 52, £6.00 paper).

Research paper discusses results of surveys undertaken of companies and grant-seeking charities in the U.K. Five chapters cover the background of the current U.K. disclosure requirements for political and charitable contributions, charitable giving by U.K. companies, the usefulness of the disclosure requirements, and possible effects of the legislation. Christopher Cowton is at the University of Wales Institute of Science and Technology, Cardiff.

Henry A. Davis, *Cash Management and the Payments System: Ground Rules, Costs, and Risks* (Morristown, NJ: Financial Executives Research Foundation, 1986, pp. viii, 102, $12.00 paper).

Five chapters describe cash management and payments systems in the U.S. as a product of the banking structure. Using the E. F. Hutton case to define ground rules, book shows how cash management practices and priorities are changing, discusses limiting risk with daylight overdraft caps, and analyzes current trends and issues in the field. Study is based partly on 250 responses by corporations and banks to a survey. Henry A. Davis is Director, Consulting Services of The Globecon Group.

N. A. EASTAWAY and E. P. MAGRIN, *Tax Aspects of Company Reorganisations* (London: The Institute of Chartered Accountants in England and Wales, pp. 356, £14.95 paper, £17.50 cloth).

The authors draw from their personal experience to provide a "comprehensive guide to tax planning and to the opportunities for arranging transactions in the most tax-efficient manner." Designed as a reference work for accountants involved in company tax planning, the book offers solutions to real-life problems. Nigel Eastaway and Edward Magrin are partners in Moores & Rowland, lecturers, and authors.

J. R. EDWARDS, Editor, *Reporting Fixed Assets in Nineteenth-Century Company Accounts*, Accounting Thought and Practice Through the Years series (New York and London: Garland Publishing, Inc., 1986, pp. 570, $40.00).

Anthology examines the range of fixed asset valuation procedures used by statutory and registered companies in Great Britain during the 19th century, assesses the legal and other influences that favored the adoption of one procedure over another, and examines some of the possible economic effects of the choices made. The collection contains 27 articles, reports, and extracts from books written on the subject between 1849 and 1985. J. R. Edwards is Senior Lecturer in Accountancy and Financial Control at University College, Cardiff, U.K.

The Fifth International Congress on Accounting, 1938 [*Kongress-Archiv 1938 Des V. Internationalen Prüfungs-Und Treuhand-Kongresses*], Reprint, Accounting Thought and Practice Through the Years series, Volume I: pp. 311; Volume II: pp. xv, 848; Volume III: pp. xv, 724; Volume IV: pp. xv, 576 (New York and London: Garland Publishing, Inc., [1938] 1986, $365.00).

Four volumes cover the 1938 Fifth International Congress on Accounting in Berlin. Volume I, written in German, lists the 1600 participants from over 60 countries, provides an introduction, and describes the opening and closing sessions as well as the social events. Volumes II, III, and IV contain the national papers, each published in two languages (English, French, German, or Italian). The eight topics covered include matters affecting the accounting profession, business planning, audit of annual accounts, company law, 55H auditing of combines, auditing by and for tax authorities, other auditing and advisory work, and methods of computing cost and control of prices by public authorities. Volume IV also includes the scientific lectures "German and American Theories on Accountancy" and "International Comparison of Research into, and Study of, Business Cooperation."

WILLIAM GORDON, *The Universal Accountant, Volume II*, Reprint, Accounting Thought and Practice Through the Years series (New York and London: Garland Publishing, Inc., [1765] 1986, pp. vi, 466, $70.00).

Reprint of the 1765 text titled *The Universal Accountant, and Complete Merchant, Volume II*, which was published in Edinburgh. Four parts cover the elements and practice of mercantile accounting, negotiation of bills of exchange and promissory notes in Europe, and a brief review of the British import/export customs. At the time of original publication, William Gordon was a teacher and co-founder of the Mercantile Academy in Glasgow.

R. H. GRAY, *Accounting for R&D: A Review of Experiences with SSAP 13*, Research Paper (London: The Institute of Chartered Accountants in England and Wales, 1986, pp. 155, £6.00 paper).

Study investigates the experiences of companies, auditors, and investment analysts in the U.K. with the accounting treatment and disclosure of research and development expenditures. Eleven chapters review the background to the study; survey the economics and accounting literature on R&D; and present the results of the analysis of company data and questionnaires from companies, analysts, and auditors. Four appendices contain the form of the questionnaire, FASB rules on R&D, and suggestions for accounting for R&D. R. H. Gray is a Lecturer in Accounting, University College of North Wales, Bangor.

STANLEY D. HALPER, GLENN C. DAVIS, P. JARLATH O'NEIL-DUNNE, and PAMELA R. PFAU, *1986 Supplement to the Handbook of EDP Auditing* (Boston: Warren, Gorham and Lamont, 1986, paginated by section, $85.50 (sold with handbook only)).

Supplement to the *Handbook of EDP Auditing*, reviewed in the October 1986 issue. An expansion on the Handbook, published by Coopers and Lybrand and its Computer Audit Assistance Group, including materials produced since 1985. The Supplement focuses on developments in systems and auditing, given rapidly changing technology. Stanley D. Halper, Glenn C. Davis, and P. Jarlath O'Neil-Dunne are Partners of Coopers and Lybrand. Pamela R. Pfau is a Manager in the National Computer Audit Assistance Group of Coopers and Lybrand.

M. SHAMSUL HAQUE, *Lotus 1-2-3 Made Easy* (Silver Spring, MD: Namuk International, Inc., 1985, pp. viii, 152, $9.95 paper).

Nine lessons deal with PC system hardware, installation of Lotus 1-2-3 system, Lotus 1-2-3 tutorial, preparation and modification of a worksheet, advanced spreadsheet techniques, graphing, and Lotus' database management system. Each lesson contains a set of instructions with samples of worksheets, reports, or graphs that further explain the lesson. Book is not a substitute for the Lotus 1-2-3 user's manual. M. Shamsul Haque is Professor of Accounting, School of Business and Public Administration at Howard University.

Harmonization of Accounting Standards: Achievements and Prospects (Paris: Organisation for Economic Co-operation and Development, 1986, pp. 147).

Excerpts from an OECD conference, the Forum on Harmonization of Accounting Standards, held on April 23 and 24, 1985. The objectives of the Forum were to stimulate discussion among the Forum's 180 participants on issues related to harmonization of national and international standard-setting. The proceedings of the Forum are presented in three chapters concerning the features, promotion, and problems of harmonization. Conclusions from the Forum are summarized in a fourth chapter by the Working Group on Accounting Standards.

A History of Cooper Brothers & Co. 1854 to 1954, Reprint, Accounting Thought and Practice Through the Years series (New York and London: Garland Publishing, Inc., [1954] 1986, pp. xi, 116, $25.00).

Chronicles important dates and incidents which have influenced the growth of the firm in the U.K. and overseas and have shaped the principles on which it conducts its business. Includes: chronological lists of partners in the U.K. and partners and staff who served the firm for a period of 25 years or more; lists of branches and associated firms overseas and places where the firm practiced or was in association; descriptions of various firms which were merged with Cooper Brothers; and a review of operations in Africa, Australia, New Zealand and Canada.

H. THOMAS JOHNSON, *A New Approach to Management Accounting History*, Accounting Thought and Practice Through the Years series (New York and London: Garland Publishing, Inc., 1986, pp. 152, $20.00).

Reprints of nine articles and papers written by Johnson which study the historical development of internal accounting practices associated with management accounting. The first section provides historical case studies of Lyman Mills (1850s), DuPont (1903–1912), and General Motors (1920s); the rest of the book gives new interpretations of management accounting history. H. Thomas Johnson is Professor of Accounting at Pacific Lutheran University in Tacoma, Washington.

CHARLES W. KYD, *Financial Modeling Using Lotus 1-2-3* (Berkeley, CA: Osborne McGraw-Hill, 1986, pp. xi, 422, $16.95 paper).

First six chapters discuss a system designed to create more informative management reports using Lotus 1-2-3 spreadsheets. The data bank and spreadsheets are used to report working capital, cash flow, and operating and financial trends. Two chapters present different sales forecast spreadsheets. Five cash flow chapters cover methods of monitoring working capital components and creation of loan amortization schedules. Four chapters on performance analysis create worksheets that facilitate break-even analyses, financial distress forecasts (Z-scores), sustainable growth computations, and sales variance summaries. Charles Kyd has worked with manufacturing, high-tech, and start-up companies.

RALPH LANDAU and DALE JORGENSON, *Technology and Economic Policy* (Cambridge, MA: Ballinger Publishing Company, 1986, pp. xvi, 344, $29.95).

Volume is based on the proceedings of a Conference on Technology and Economic Policy, held in Washington, D.C., on February 4-5, 1985. Eleven of the 14 papers address questions related to the overall impact of business taxation and the effect of specific tax provisions on innovation, the supply of venture capital, the taxation of capital gains, and the recovery of capital costs. Attention also is given to federal deficits. Ralph Landau is a recipient of the National Medal of Technology and has many affiliations with universities and industry. Dale Jorgenson is Frederic Eaton Abbe Professor of Economics at Harvard University.

T. A. LEE, Editor, *A Scottish Contribution to Accounting History*, Accounting Thought and Practice Through the Years series (New York and London: Garland Publishing, Inc., 1986, pp. 149, $20.00).

Anthology contains 14 previously published articles which can be divided into two groups. The first of the two sections deals with accounting thought and practice before the emergence of regulation in the mid-19th century. The second section discusses the first 60 or 70 years of the accountancy profession and some of the problems it faced. The book was published on behalf of the Scottish Committee on Accounting History of the Institute of Chartered Accountants of Scotland. The editor is Professor and Head of the Department of Accounting and Business Method, University of Edinburgh.

RICHARD S. LEHMAN, *Programming for the Social Sciences: Algorithms and Fortran77 Coding* (Hillsdale, NJ and London: Lawrence Erlbaum Associates, Inc., 1986, pp. xvi, 575, $24.95 paper, $59.95 cloth).

Thirteen chapters cover the nature and process of programming, problem solving and algorithm design, elementary Fortran77 coding, program organization, control structures, data representation, number mazes and data structures, formatted input and output, character data, subprograms, input and output using files and other devices, other declarations, and programming practices. Book is written at a level appropriate for an undergraduate or first-year graduate student. Richard Lehman is at Franklin and Marshall College.

G. A. MILNES and D. R. TILLETT, *Property Company Accounts*, An Industry Accounting and Auditing Guide (London: The Institute of Chartered Accountants in England and Wales, 1986, pp. 157, £12.50 paper).

Book identifies best current practices and main accounting problems of property companies. Twelve chapters cover topics including distributable profits, development outgoings, property valuations, dealing, profit and loss accounts, assets, reserves and liabilities, source and application of funds, miscellaneous points of principle, and special factors affecting the auditor. Eight appendices include the accounting practices adopted by major British property investment and dealing companies for certain reserves and liabilities, completed investment properties and development and dealing properties, extracts from the 1985 accounts of three of the major property companies, and the text of SSAP 19. Alan Milnes is a Partner in Peat Marwick Mitchell & Co. and David Tillett is a Partner in Binder Hamlyn.

CHRISTOPHER NOBES, *Issues in International Accounting*, Accounting Thought and Practice Through the Years series (New York and London: Garland Publishing, Inc., 1986, pp. 157, $20.00).

Anthology presents 12 papers on international accounting issues written by Nobes in the first half of the 1980s. Financial reporting topics such as classification, harmonization, and multinational group accounting are discussed. Other papers make comparisons of different international corporate tax systems and discuss variations in perceptions of accounting journals. Christopher Nobes is Professor of Accounting at the University of Strathclyde, Scotland.

LEE D. PARKER, *Communicating Financial Information Through the Annual Report*, Research Paper (London: The Institute of Chartered Accountants in England and Wales, 1986, pp. iii, 86, £6.00 paper).

Study is based on work carried out in Australia, the U.S., and the U.K. Eight chapters deal with annual report objectives, report user preferences, financial communication strategy, differential disclosure, use of highlights statements, implications of study for reporting practices, and directions for further research. Lee Parker is a Professor at the School of Social and Industrial Administration, Griffith University in Queensland, Australia.

LEE D. PARKER, *Value-For-Money Auditing: Conceptual, Development and Operational Issues*, Auditing Discussion Paper No. 1 (Caulfield, Victoria: Australian Accounting Research Foundation, 1986, pp. iv, 92, Aus. $15.95 paper).

Research paper is designed to provide an input to ongoing discussions of the appropriateness of and desirable direction for the development of the value-for-money audit concept and its application in Australia. Six chapters deal with problems of definition, past and present worldwide practice, conceptual issues, operational aspects, and issues affecting the direction of future developments in Australia. Lee Parker is Professor of Accounting, School of Social and Industrial Administration, Griffith University, Brisbane, Queensland.

GARY JOHN PREVITS and ALFRED R. ROBERTS, Editors, *Federal Securities Law and Accounting 1933-1970: Selected Addresses*, Accounting Thought and Practice Through the Years series (New York and London: Garland Publishing, Inc., 1986, pp. 348, $22.00).

Volume contains unpublished addresses by commissioners and principal staff members of the Securities and Exchange Commission covering the developments of the first 37 years of the Securities Acts. Each address is preceded by an abstract and a profile of the speaker. The focus of the materials includes early activities and cases at the SEC, the relationship of the SEC with other professionals and corporate investors, and considerations relating to disclosure requirements and accounting methods. Foreword was written by Andrew Barr. The editors are both past Presidents of the Academy of Accounting Historians. Gary John Previts is Chairman and Professor, Department of Accountancy at Case Western Reserve University. Alfred R. Roberts is Professor of Accounting, George State University.

JEAN MARGO REID, Editor, *Law and Accounting, Pre-1889 British Legal Cases*, Accounting Thought and Practice Through the Years series (New York and London: Garland Publishing, Inc., 1986, pp. 182, $22.00).

Book contains edited versions of 30 British legal cases involving accounting issues decided from 1849 to 1888. Among the issues covered are asset valuation, including depreciation, depletion, and appreciation; accounting for risks, bad debts, foreign exchange transactions, and treasury shares; and questions regarding income recognition and the matching of revenues and expenses. Editor is Assistant Professor of Business Law at New York University.

MORTON B. SOLOMON, KENNETH J. DIRKES, and JOHN R. DEMING, Editors, *KMG Main Hurdman: Guide to Preparing Financial Reports*, 1987 Edition (New York; Chichester, England; Brisbane; Toronto; Singapore: A Ronald Press Publication, John Wiley & Sons, 1987, pp. viii, 411, $90.00 paper).

Guide was developed by KMG Main Hurdman to help those involved in preparing financial reports. Seven sections summarize professional requirements as of August 1, 1986 as to the form and content of financial statements and the reports issued by auditors when reporting on financial statements, and offer suggestions for meeting those requirements. Marginal references are to applicable paragraph numbers in the authoritative literature (FASB, AICPA, and SEC). A Report Preparation Checklist and Current Developments Report is issued as a periodic supplement. Editors are partners at KMG Main Hurdman.

J. DAVID SPICELAND, *Directory of Dissertations in Accounting* (New York: Markus Wiener Publishing, 1986, pp. 197, $34.50).

Directory identifies title, author, school, date, and pages of dissertations written in accounting since 1972. Also classifies dissertations by 47 topics and six methodologies. Includes an alphabetical list of authors classified by methodology. Purpose is to assist in the identification of relevant prior research by doctoral students, faculty supervisors, and accounting researchers. J. David Spiceland is Professor and Interim Director of the School of Accountancy at Memphis State University.

JAS. C. STEWART, *Pioneers of a Profession: Chartered Accountants to 1879*, Reprint, Accounting Thought and Practice Through the Years series (New York and London: Garland Publishing, Inc., [1977] 1986, pp. xii, 181, $25.00).

Originally published in 1977 by the Scottish Committee on Accounting History, Institute of Chartered Accountants of Scotland. Book provides discussion of social and economic conditions within which the accountancy profession has developed. Also presents biographical notes on the members of the Scottish Chartered societies during 1854 to 1879, including backgrounds, education, places in the community, and work styles. Jas. C. Stewart, C.A., was a past President of The Institute of Chartered Accountants of Scotland.

COLIN STORRAR, Editor, *The Accountant's Magazine: An Anthology*, Accounting Thought and Practice Through the Years series (New York and London: Garland Publishing, Inc., 1986, pp. 163, $20.00).

The Accountant's Magazine, first published in 1897, is the official journal of The Institute of Chartered Accountants of Scotland. Anthology presents a selection of items published in the journal between the years 1897 and 1954 (the centenary of the Institute). Topics covered include financial accounting standards, cost accounting, income tax accounting and avoidance, accounting for inflation, industry accounting standards, the audit profession, and accounting education.

CHRISTOPHER SWINSON, *Financial Reporting Pocketbook* (London: The Institute of Chartered Accountants in England and Wales, 1986, pp. 119, £4.95 paper).

Guide to the main accounting and disclosure provisions of the Companies Act 1985. Details are provided for the balance sheet and profit and loss account formats; notes to the accounts; holding companies and group accounts; the directors' report; and disclosure requirements for special category companies such as banking and discount, insurance, and shipping companies. Three appendices are concerned with statements issued by the Institute of Chartered Accountants in England and Wales and by the International Accounting Standards Committee, disclosure requirements of The Stock Exchange (London), and examples of the required reports in the new format. Christopher Swinson is the National Director of Accounting and Auditing at Binder Hamlyn.

W. A. THOMAS, *The Big Bang* (Oxford: Philip Allan Publishers Limited; distributed in the U.S.A. and Canada by Humanities Press, Atlantic Highlands, NJ, 1986, pp. ix, 180, $17.50 paper, $29.95 cloth).

The effects of the 'Big Bang' of 1986 on the London Stock Exchange are examined in nine chapters. All major changes brought about by the event and effects on the users of the market are illuminated. The author discusses the gilt-edged and equity markets, the reasons behind the choice of dealing systems, the abandonment of fixed minimum commissions, and investor protection. W. A. Thomas is Senior Lecturer in Economics at the University of Liverpool.

S. Rao Vallabhaneni, *Auditing the Maintenance of Software* (Englewood Cliffs, NJ: Prentice-Hall, Inc., 1987, pp. xvii, 261, $35.00).

Book's four parts describe the data processing environment in which software maintenance activities are performed, provide control guidelines to allocate audit resources to activities where risks and exposure are the greatest, present audit procedures and approaches for use by auditors, and review the future of software maintenance and resultant audit approaches. Nine appendices address such topics as critical control points in applications systems, application system redesign, software metrics, software system support agreements, application system documentation manuals, and vendor software selection criteria. S. Rao Vallabhaneni is a supervising auditor for the Square D Company and teaches internal auditing courses at Roosevelt University and The University of Illinois and Certified Internal Auditor and CISA examination review courses in Chicago.

Richard Vangermeersch, Editor, *The Contributions of Alexander Hamilton Church to Accounting and Management*, Accounting Thought and Practice Through the Years series (New York and London: Garland Publishing, Inc., 1986, pp. 185, $20.00).

Collection includes 36 articles written by A. H. Church between the years 1900 and 1931. Church was a renowned expert in the fields of cost accounting and management, and also published papers on business and society and industrial engineering. This anthology of his work includes mainly the articles not previously published in book form. A chronological list of publications by Church is provided. Editor is Professor of Accounting at University of Rhode Island and President of The Academy of Accounting Historians.

Richard Vangermeersch, Editor, *Financial Accounting Milestones in the Annual Reports of United States Steel Corporation, The First Seven Decades*, Accounting Thought and Practice Through the Years series (New York and London: Garland Publishing, Inc., 1986, pp. 257, $20.00).

Book extracts sections from the annual reports of United States Steel Corporation over the period 1902 to 1968 to illustrate important milestones in the history of financial reporting in the United States. Topics covered include almost every aspect of the financial statements, footnotes, the auditor's report, and management discussions of operations. Table of contents lists the annual reports presented and relevant area discussed in each excerpt. Editor is Professor of Accounting at University of Rhode Island and President of The Academy of Accounting Historians.

Robert J. Wiley, *Real Estate Accounting and Mathematics Handbook*, Second Edition (New York; Chichester, England; Brisbane; Toronto; and Singapore: A Ronald Press Publication, John Wiley & Sons, 1986, pp. xxvi, 380, $49.95).

Second edition covers basic tools for both managerial and financial real estate accounting, including real estate mathematics; the use of finance calculators and microcomputers in real estate analysis; LOTUS 1-2-3 applications for real estate finance, investment, and income and expense analysis; HP-12C calculator applications, with examples of keystroke solutions; and exhibits illustrating real estate accounting statements and reports. Robert Wiley is a Professor at the Philadelphia College of Textiles and Science.

David A. Wilson, *Practice Inspection: Weaving a Strong New Thread Into the Professional Fabric*, Arthur Young Lecture No. 8 (Glasgow: Department of Accountancy, School of Financial Studies, University of Glasgow, 1986, pp. 29, £5.00 paper–U.K. residents, £6.00 paper–non U.K. residents).

Eighth Annual Arthur Young Lecture discusses practice inspection primarily in regard to the Institute of Chartered Accountants of Ontario. Topics include a discussion of "the professional fabric," or the accounting profession system and the related educational and regulatory organizations and processes; a discussion of the subjects of mandatory professional development and peer review, both in the U.S. and Canada; a description of how the practice inspection system works in Ontario; and comments on Ontario's experience with practice inspection to date. David Wilson is Executive Director of The Institute of Chartered Accountants of Ontario.

Editor's Note: Julianne Rappa and Catherine McNally assisted the editor in annotating these books.

BOOKS RECEIVED FROM NOVEMBER 9, 1986 TO FEBRUARY 10, 1987

Accounting and Financial Reporting by Agricultural Producers: A Research Study (Toronto: The Canadian Institute of Chartered Accountants, 1986, pp. 132, Can. $25.00 paper).

JOAN LORDI AMBLE and JULES M. CASSEL, *A Guide to Implementation of Statement 87 on Employers' Accounting for Pensions: Questions and Answers*, Special Report (Stamford, CT: Financial Accounting Standards Board, 1986, pp. vii, 106, $12.00 paper-academic or member, $15.00 paper-other).

JUDITH M. BARDWICK, *The Plateauing Trap: How to Avoid It in Your Career And Your Life* (New York: AMACOM, American Management Association, 1986, pp. xi, 209, $17.95).

AHMED BELKAOUI, *Handbook of Management Control Systems* (Westport, Connecticut: Quorum Books, 1986, pp. xiv, 355, $49.95).

IRVING L. BLACKMAN, *The Valuation of Privately-Held Businesses: State-of-the-Art Techniques for Buyers, Sellers, and Their Advisors* (Chicago: Probus Publishing Company, 1986, pp. viii, 400, $47.50).

HENRI BOUQUIN, *Le Contrôle de Gestion: Contrôle de Gestion, Contrôle d'Entreprise* (Paris: Presses Universitaires de France, 1986, pp. 298, FF145.00 paper).

ADRIAN BUCKLEY, *Multinational Finance* (Oxford: Philip Allan Publishers Limited; distributed in the U.S.A. and Canada by Humanities Press, Atlantic Highlands, NJ, 1986, pp. x, 398, $29.95 paper, $70.00 cloth).

HELEN BUTCHER, assisted by ELIZABETH OLDROYD, "Sources of Information for Corporate Investigations," *Accountants Digest No. 199* (London: The Institute of Chartered Accountants in England and Wales, 1986, pp. 52, £6.00).

D. R. CARMICHAEL and MARTIN BENIS, *Auditing Standards and Procedures Manual: 1986–1987* (New York; Chichester, England; Brisbane; Toronto and Singapore: A Ronald Press Publication, John Wiley & Sons, 1987, paginated by section, $75.00).

JEROME B. COHEN, SIDNEY M. ROBBINS, and ALLAN E. YOUNG, *The Financial Manager* (Columbus, OH: Publishing Horizons, Inc., 1986, pp. xv, 748).

CHRISTOPHER J. COWTON, *A Study of the Disclosure of Charitable Donations by Companies in the United Kingdom*, Research Paper (London: The Institute of Chartered Accountants in England and Wales, 1986, pp. ii, 52, £6.00 paper).

COLIN G. DAVIS and MICHAEL READER, "A Guide to the Finance Act 1986," *Accountants Digest No. 194* (London: The Institute of Chartered Accountants in England and Wales, 1986, pp. v, 99, £7.00 paper).

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JULY 1987 PLACEMENT ADS

The deadline for information to be included in the "Placement Information" section is two months prior to the date of publication. The Review *is published on the first day of January, April, July, and October. Placement advertising and replies should be sent to the American Accounting Association, 5717 Bessie Drive, Sarasota, FL 33583. All replies to box numbers should be on separate sheets to facilitate forwarding. There is no charge for this service to AAA members and associate members seeking employment. Others will be charged a fee of $100 per insertion. Ads should not exceed 100 words.*

#301 THE UNIVERSITY OF MICHIGAN-FLINT has openings for tenure-track faculty positions at all ranks starting in either September or January. Most interest areas can be accommodated, although preference will be given to candidates in auditing and accounting information systems. Professional certification is desirable. Responsibilities include quality teaching, research, and service. Candidates must have a doctorate or be in the last stages of ABD. Salary is competitive and fringe benefits are excellent. Candidates should send a resumé to: Dr. Walter J. Woerheide, School of Management, University of Michigan-Flint, Flint, MI 48502-2186. Applications accepted until position is filled. The University of Michigan-Flint is an equal opportunity/affirmative action employer.

#302 RHODES COLLEGE invites applications for a tenure track position beginning August 1988. The doctorate is required, and applicants must show evidence or promise of excellence in both teaching and research. Rhodes College is a selective, private, coeducational college of the liberal arts and sciences with a student-faculty ratio of 12 to 1 and a very successful accounting program. The teaching load is 9 hours per semester. The salary is competitive and generous research grants and travel funds are available. Send resumé and 3 letters to Dr. Marshall E. McMahon, Rhodes College, Memphis, TN 38112. Affirmative Action/Equal Opportunity Employer.

#303 SUFFOLK UNIVERSITY, Boston, Massachusetts. The Accounting Department of the School of Management is seeking faculty members to fill tenure-track positions. Teaching will be at the undergraduate/graduate level(s). Primary openings in governmental fund accounting, managerial or financial areas. Qualified candidates should be able to teach in a second accounting area. Evidence of effective teaching, research competence and a strong record of publications required. PhD/DBA in Accounting required. CPA, CMA, or other certification(s) desirable. Apply to Ronald Sundberg, Associate Dean, School of Management, Suffolk University, Beacon Hill, Boston, MA 02108 or call (617) 723-4700, ext. 307. An equal opportunity affirmative action employer.

#304 All positions, tenure-track, for the 1987–88 year. Minimum qualifications: Ph.D. or DBA in Accounting (ABD considered if dissertation in process). Undergraduate and graduate level teaching. Salary is competitive. Send resumé to: Teddy L. Coe, Department of Accounting, North Texas State University, Denton, Texas 76203. NTSU is an Equal Opportunity, Affirmative Action Employer.

#305 CALIFORNIA STATE UNIVERSITY, LOS ANGELES is accepting applications from candidates for Assistant, Associate and Full Professor positions for 1987–88. Tenure-track and one-year appointments are available. Tenure-track positions normally require a doctorate or ABD, except in taxation which requires a J.D. or MBT. Candidates should be able to demonstrate teaching effectiveness and research capabilities. The Department's strongest needs are for persons who can teach financial accounting (under-graduate and graduate). California State University, Los Angeles is an Equal Opportunity/Affirmative Action Employer. Interested candidates are invited to submit their curriculum vitae to Gary V. Jorden, Chair, Department of Accounting, California State University, Los Angeles, CA 90032.

#306 POSITION WANTED: Ph.D. in Accounting and professional certificate. Twelve years of full-time teaching experience and some publications. Currently a tenured associate professor. Primary areas are cost/managerial and financial. Available after June, 1988.

#307 The University of Saskatchewan (Canada) is seeking applicants for tenurable and limited term (visiting) positions in Accounting. Rank and salary commensurate with experience and credentials. Strong interests in teaching and research required for both enriched undergraduate program, as well as MBA and M.Sc. Accounting programs. Current department establishment of fourteen hold doctorates from Michigan, Washington, Minnesota, Missouri and Michigan State. Saskatoon is a beautiful, pollution-free Western Canadian university city of 180,000 with excellent schools and cultural facilities. Further information can be obtained from: Department Head, Department of Accounting, University of Saskatchewan, Saskatoon, Saskatchewan, Canada S7N 0W0.

#308 APPLICATIONS FOR POSITIONS IN ACCOUNTING, at all professorial ranks, are invited from qualified persons having research and teaching interests in the areas of auditing, financial, health care, information systems, managerial, and public policy. A Ph.D. is required. Demonstrated ability or potential for effective teaching and quality research are important considerations. The University of Pennsylvania is an equal opportunity/affirmative action employer. Interested persons should send their resumé including educational background, professional experience, publications, personal data, and, if applicable, a dissertation proposal and abstract to: Professor Robert E. Verrecchia, Accounting Department, University of Pennsylvania, Suite 2400 Steinberg Hall-Deitrich Hall, Philadelphia, PA 19104-6365.

#309 THE UNIVERSITY OF ALASKA, ANCHORAGE, has an anticipated full-time, tenure-track position in Accounting available for Fall 1988. Ph.D., D.B.A., or in doctoral dissertation stage in Accounting required. Applicants must have a demonstrated capability for scholarly research and publication as well as demonstrated teaching capability. Primary teaching responsibilities will be in accounting. Additional teaching experiences available if desired. University of Alaska promotion and tenure standards include teaching, research, and publication. Salary and rank commensurate with experience. For additional information contact Dr. Joseph Merrill, Coordinator for Accounting Programs, School of Business and Public Affairs, University of Alaska, Anchorage, 3211 Providence Dr., Anchorage, AK 99508; phone (907) 786-4866. MAKE APPLICATION TO: Personnel Office, University of Alaska, Anchorage, 3211 Providence Drive, Anchorage, AK 99508; phone (907) 786-1419. Closing Date: 12/15/87. UAA is an EO/AA employer & educational institution.

#310 THE UNIVERSITY OF TOLEDO. The Department of Accounting invites applications for positions in TAXATION effective January or September 1988. Candidates should possess a doctorate with a specialty in accounting and/or taxation. Persons holding the combination of JD, MBA, CPA will also be considered. Salary for the appointment is very competitive. The University of Toledo has an enrollment of approximately 20,000 students. The campus is located in an excellent neighborhood which enables many of the faculty to walk to their offices. The Accounting Department offers an undergraduate degree in accounting, as well as a Master of Science in Accounting degree and the MBA. A Master of Taxation degree program is presently in the authorization process, and should be underway in January 1988. Send vita to: Dr. Larry F. Konrath, Chairman, Department of Accounting, The University of Toledo, Toledo, OH 43606. The University of Toledo is an Equal Opportunity/Affirmative Action Employer.

#311 CHAIRPERSON, THE UNIVERSITY OF TOLEDO. The Department of Accounting invites nominations and applications for the departmental chairperson. Candidates should possess a doctorate, preferably with accounting as a major area of study. Applicants should have established credentials sufficient to support a senior level faculty appointment. Salary for the appointment is very competitive. The University of Toledo has an excellent neighborhood which enables many of the faculty to walk to their offices. The Accounting Department offers an undergraduate degree in accounting, as well as a Master of Science in Accounting degree and the MBA. A Master of Taxation degree program is presently in the authorization process, and should be underway by January 1988. Send vita to: Dr. Larry F. Konrath, Chairman, Department of Accounting, The University of Toledo, Toledo, OH 43606. The University of Toledo is an Equal Opportunity/Affirmative Action Employer.

#312 THE SCHOOL OF ACCOUNTING AT OKLAHOMA STATE UNIVERSITY seeks applicants for the Arthur Andersen & Co. Alumni Centennial Professorship. Applicants should possess a distinguished record of research and teaching and be capable of assuming a major role in the academic and professional mission of the School. Activities of the professor are expected to include conducting scholarly research, contributing to the research and teaching activities of faculty, and active participation in the doctoral program. The initial appointment is five years, renewable thereafter at three-year intervals. Benefits beyond the resources and privileges accorded School of Accounting faculty members, include a generous salary supplement, a six-hour per semester teaching load, and summer research support for two of every three summers during the tenure of the appointment. The appointment date is Fall 1988, and applications should be received by December 1, 1987. Send resumé to Dr. Lanny G. Chasteen, Search Committee Chairman, School of Accounting, Oklahoma State University, Stillwater, OK 74078. OSU is an equal opportunity, affirmative action employer.

#313 THE UNIVERSITY OF MISSOURI-COLUMBIA, School of Accountancy, College of Business and Public Administration, has a tenure-track faculty position available for Fall 1988. The University is an Equal Opportunity, Affirmative Action Employer. Applications from minority members and women are encouraged for these positions. A Ph.D or near completion is required. An interest in a mix of research, quality teaching, and service is preferred. Please send vita to: Dr. Thomas P. Howard, Chair, Accountancy Recruiting Committee, University of Missouri Columbia, 312 Middlebush Hall, Columbia, Missouri 65211.

#314 THE UNIVERSITY OF MANITOBA is seeking applicants for tenure-track positions in accounting for July 1988. Rank is open, based on qualifications and experience. A visiting appointment is also possible. Ph.D. or DBA, completed or near completion is required. Duties include research and teaching at the undergraduate and graduate levels. Salary is competitive and will depend on qualifications, experience and research record. Winnipeg, a multicultural city of 600,000, offers the best of an urban environment in the heart of Canada's vacation land. Both women and men are encouraged to apply. In accordance with Canadian immigration requirements, priority will be given to qualified Canadian citizens and permanent residents of Canada. Applications should be sent to: DR. L. I. GOULD, HEAD, DEPARTMENT OF ACCOUNTING AND FINANCE, UNIVERSITY OF MANITOBA, WINNIPEG, MANITOBA R3T 2N2.

#315 THE UNIVERSITY OF RICHMOND has two tenure track positions in accounting for the 1988-89 school year. Rank and salary are open depending on qualifications. Candidates should have a Ph.D. or DBA in Accounting and an interest in the financial or managerial/systems areas. The teaching load is 9 hours with two preparations. Class sizes average 20-30. The University places a balanced emphasis on teaching and research and required qualifications include a demonstrated record or potential in both of these areas. The University of Richmond is located on a beautiful residential campus at the edge of Richmond, Virginia. It has a $200 million endowment—placing it among the top 50 endowments in the country. The University of Richmond is an equal opportunity/affirmative action employer. Applications should include a letter of application, vita, and the names of three references. CONTACT: Francis A. Bird, Chairman, Accounting Department, E. Claiborne Robins School of Business, University of Richmond, VA 23173.

#316 MANAGEMENT ACCOUNTANT 4 yrs. experience. B.S. in Accounting or equivalent. Must have passed CPA exam and have public accounting knowledge and experience. Duties: Evaluate existing corporate financial structure; determine and identify areas of weakness, development and expansion, e.g. profitability studies, cash flow projections and cash management; make recommendations on implementation of new accounting and procedures and control. Job location/interview: Los Angeles, CA. Salary: $40,000/yr. Send this ad and your resumé/letter stating your qualifications to Job #DC-2595, P.O. Box 9560, Sacramento, CA 95823-0560. Not later than August 15, 1987.

#317 UNIVERSITY OF LOUISVILLE ASSISTANT PROFESSOR OF ACCOUNTING. An appointment as Assistant Professor of Accounting will be available in the Department of Accountancy for Fall 1988. Minimum qualifications are: A Ph.D. or DBA in accounting, demonstrated potential for teaching effectiveness and demonstrated potential for quality research capabilities. ABD's will be considered if substantial progress has been made on the dissertation. Beyond minimal qualifications, preference will be given for possession of CPA, CMA, or CIA certification. Preferred areas of teaching and research are financial, and/or auditing. Deadline for application is September 15, 1987. The undergraduate Accountancy Program is accredited by AACSB. If you wish to take advantage of this opportunity, send your vita to: Dr. Alan Attaway, Chairman, Department of Accountancy, School of Business, University of Louisville, Louisville, KY 40292. AN EQUAL OPPORTUNITY/AFFIRMATIVE ACTION EMPLOYER.

#318 THE UNIVERSITY OF SAN DIEGO, School of Business, is seeking applications for tenure-track appointments at the Assistant or Associate Professor levels. All teaching areas are available in the undergraduate, MBA and MS (Tax) programs with special needs in (1) managerial, (2) auditing, and (3) tax. The university numbers 5,000 students and the School of Business is AACSB accredited. Ph.D. or DBA required. ABD also considered. If you think that a small, quality-oriented school where your input counts is where you would like to be, we would like to talk with you at the national AAA meeting in Cincinnati. Please contact Dr. Jim Daniels, School of Business, University of San Diego, San Diego, CA 92110. (619) 260-4875.

#319 VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY invites applications and nominations for the William S. Gay, L. Mahlon Harrell and Robert B. Pamplin Professorships in Accounting. Applicants/nominees should have a demonstrated record of excellence in research and teaching. The appointments will be at the senior level with compensation and research supplements provided by the professorships. Applications will be accepted until September 1, 1987 or until the positions are filled. Applications and nominations should be sent to: Wayne E. Leininger, Department of Accounting, 222 Burruss Hall, Virginia Tech, Blacksburg, VA 24061. Virginia Tech is an Equal Opportunity Affirmative Action Employer and encourages applications from all qualified individuals.

#320 Available as Visiting Professor: PhD, CPA, CDP. Primary teaching interests are Auditing, Accounting Systems, and Managerial Accounting. Desired location Southwest, Florida, and California. Over 17 years teaching experience and 10 years of auditing. Available September 1988 and can arrange for initial interview at AAA meeting in Cincinnati in August. Please send all inquiries to: Jacob B. Paperman, 2449 S. Old Oaks Drive, Beavercreek, Ohio 45431.

#321 OAKLAND UNIVERSITY, Rochester, Michigan. The Accounting Department of the School of Business Administration is seeking faculty members to fill tenure track positions. A Ph.D./DBA in accounting is required; ABD will be considered. Evidence of effective teaching research competence is expected. Oakland is a state supported university of 12,000 students and is located 20 miles north of Detroit. Business School enrollment is 2,000 undergraduates and 300 MBA students. Compensation is competitive and includes superior fringe benefits. Send vita to Gadis J. Dillon, Chair, Accounting Department, Oakland University, Rochester, Michigan 48309-4401. Oakland University is an equal opportunity, affirmative action employer.

#322 DEPARTMENTAL CHAIR: WRIGHT STATE UNIVERSITY (AACSB Accredited College) is seeking a chair for the Department of Accountancy starting July 1988. Candidate must have Doctorate and be qualified for appointment as a Full Professor. The chair provides leadership to 12 full-time faculty and should have a proven record of excellence in teaching, research and service. The candidate must be willing and able to maintain a strong relationship with the professional community and should have a professional certification. The College offers a BS with an Accounting Major and an MBA with an Accounting Concentration. Salary is competitive and is dependent on credentials and experience. Candidates should send a resumé to Accounting Chairperson Search Committee, Attention: M. Adams, College of Business and Administration, Wright State University, Dayton, Ohio 45435. Review of applicants will begin at the AAA Convention August 17, 1987 and continue until position is filled. Wright State University is an affirmative action, equal opportunity employer.

#323 WRIGHT STATE UNIVERSITY has a tenure-track faculty openings for 1988-89. Areas of primary interest are auditing, systems and financial. PhD or candidate in dissertation stage required. Professional certification desired. Rank dependent upon credentials. MBA/CPA with teaching and practical experience will be considered for non-tenured appointment as instructor. Competitive salary with excellent fringe benefits. Programs AACSB accredited. Send letter of application and resumé with references to J. B. Paperman, Department of Accountancy, Wright State University, Dayton, Ohio 45435. Review of applicants will begin at AAA Convention August 17, 1987 and will continue until position is filled. Wright State University is an affirmative action, equal opportunity employer.

#324 GEORGE MASON UNIVERSITY FOUNDATION PROFESSORSHIP. The Department of Accounting and Business Legal Studies invites applications or nominations for a GMU Foundation Professorship for Fall 1988. Candidates should have the following: doctoral degree; expertise in auditing, financial or managerial accounting; excellent research record; and doctoral program experience with seminars and dissertation committees. Candidates will be expected to teach 3 to 6 hours per semester and be actively involved in research. George Mason University, the State University of Northern Virginia, is located approximately 20 miles west of Washington, DC, providing excellent research and consulting opportunities. The university is a dynamic growing institution with *17,500* students. The School of Business Administration has over *3,400* students of which over *400* are enrolled in undergraduate and graduate accounting degree programs. Applications should be sent to: Chair, Accounting/Business Legal Studies, School of Business Administration, George Mason University, 4400 University Drive, Fairfax, VA 22030. George Mason University is an Affirmative Action/Equal Opportunity Employer.

#325 GEORGE MASON UNIVERSITY. The Department of Accounting and Business Legal Studies invites applications for assistant, associate, and full professor tenure-track positions for Fall 1988. Assistant candidates should have doctorate or ABD near completion. Associate and full candidates must have a commensurate research and professional service record. Faculty members are generally expected to teach six to nine hours per semester and be actively involved in research and professional service. George Mason University, the State University of Northern Virginia, is located approximately 20 miles west of Washington, DC, providing excellent research and consulting opportunities. The university is a dynamic, growing institution with *17,500* students. The School of Business Administration has over *3,400* students of which over *400* are enrolled in undergraduate and graduate accounting degree programs. Applications should be sent to: Chair, Accounting/Business Legal Studies, School of Business Administration, George Mason University, 4400 University Drive, Fairfax, VA 22030. George Mason University is an Affirmative Action/Equal Opportunity Employer.

#326 MBA, CPA 19 years accounting experience, 10 years teaching, 6 years full-time SEEKS: Full-time tenure track position, New York Metropolitan areas. A position which would not require doctorate for tenure. Box 3194, Scarsdale, NY 10583.

#327 THE UNIVERSITY OF COLORADO AT DENVER seeks applications for faculty positions at the advanced Assistant, Associate, and Full Professor levels. Qualifications include a doctoral degree and commitment to excellence in research and teaching. The College of Business on the Denver Campus has recently become an independent unit and has grown from a faculty of 10 in 1980 to over 30 research-oriented faculty members in the current year. Salary and research support are competitive. Recruiting begins immediately and continues until the positions are filled. Contact Professor Dennis Murray, University of Colorado at Denver, College of Business, 1475 Lawrence Street, Denver, CO 80202. The University is an Equal Opportunity, Affirmative Action Employer.

#328 THE UNIVERSITY OF TULSA, SCHOOL OF ACCOUNTING, has Fall 1987 openings for tenure-track positions in financial accounting. Terminally qualified individuals preferred, but may consider ABD's. Rank and salary depend upon qualifications, and offers will be competitive. The University offers the opportunity to provide, and to be rewarded for, balanced contributions in research and teaching. Academic (particularly empirical) research is a priority. The University has a strong undergraduate tradition in the Liberal Arts, stresses high quality research and teaching. Send vita to Don Vickrey, School of Accounting, The University of Tulsa, Tulsa, OK 74104. An equal/opportunity/affirmative action employer.

#329 TEXAS CHRISTIAN UNIVERSITY is seeking to fill several accounting positions at all professorial levels and at the Instructor level. Visiting appointments can be considered. The professorial positions require a Ph.D. degree, with the senior level requiring a substantial record of academic research. Instructors must hold a Masters degree. TCU is a well-endowed, private university of approximately 7,000 students. Applications will be accepted until the positions are filled. They should be sent to: Donald R. Nichols, Chairman, M. J. Neeley School of Business, Texas Christian University, Fort Worth, Texas 76129. TCU is an Equal Opportunity/Affirmative Action Employer.

#330 BOSTON COLLEGE is seeking applications for appointments at the Assistant or Associate levels in Accounting. Applicants for Assistant should possess a Ph.D. or D.B.A. ABD's will be considered. Applicants for Associate must have a proven record in teaching, research, and service. Boston College places a high emphasis on quality teaching. In addition, applicants will be expected to engage in scholarly research and will be supported in their research efforts. The School of Management is AASCB accredited. Boston College is an Equal Opportunity/Affirmative Action Employer. Contact: Dr. Ronald Pawliczek, Department of Accounting, Fulton 400, Boston College, Chestnut Hill, MA 02167.

#331 CLAREMONT McKENNA COLLEGE making endowed tenure-track accounting appointment beginning Fall 1988. Financial Accounting, Auditing and/or Tax Law. Demonstrated interest in undergraduate teaching and scholarly research essential. Ph.D. required, professional certification preferred. Associate or Full Professor; salary competitive. CMC is a member of Claremont Colleges. Admission highly selective; program enjoys strong support. At Cincinnati AAA meetings; other interview locations possible. Send resumé by 15 November 1987 to Chairman, Accounting Search, Dean of Faculty's Office, Bauer Center, 500 E. 9th Street, Claremont McKenna College, Claremont, California 91711. College is affirmative action, equal opportunity employer.

#332 THE UNIVERSITY OF VERMONT School of Business Administration invites applications for tenure-track accounting position at the Assistant Professor level beginning September 1988. Candidates should possess doctorate in accounting or be nearing completion of degree. Professional certification desirable. Salary competitive; excellent fringe benefits. Undergraduate business and MBA programs are AACSB accredited. Apply to: Peter E. Battelle, School of Business Administration, University of Vermont, Burlington, Vermont 05405. Telephone (802) 656-3177. Application Deadline: November 1, 1987 or until position filled. Applications received by early August will allow opportunity to meet with potential candidates at AAA convention. Vermont is an Equal Opportunity, Affirmative Action Employer. Women and minority candidates encouraged to apply.

#333 THE UNIVERSITY OF ARKANSAS will interview applicants at the AAA meeting in Cincinnati for tenure-track positions at the assistant or associate professor level beginning Summer or Fall 1988. We are interested in adding faculty who are qualified and motivated to engage in research that leads to publication. The faculty member must also be a good teacher. A Ph.D./DBA or doctoral dissertation stage is required. The College of Business Administration and the Department of Accounting have accreditation for both the undergraduate and graduate programs, and the College administers the only Ph.D. program in the state. To arrange an interview in Cincinnati, send a resumé to Dr. Jackson A. White, Department of Accounting, University of Arkansas, Fayetteville, AR 72701. Telephone: (501) 575-4051.

#334 Assistant Professor, Accounting. THE UNIVERSITY OF RHODE ISLAND. Two (2) tenure-track positions at the Assistant Professor level for Fall 1988. Candidates should have a strong commitment toward quality research and teaching. URI is accredited by the AACSB. Salary and benefits are competitive. Ph.D./DBA with Accounting concentration or ABD near completion required. CPA/CMA preferred. Applications will be accepted until both positions are filled. Applicants should submit a resumé to: Henry Schwarzbach, Search Committee Chair, Assistant Professor, Accounting (040081) Position, THE UNIVERSITY OF RHODE ISLAND, P.O. Box G., Kingston, R.I. 02881. An affirmative action/equal opportunity employer m/f/

#335 WINONA STATE UNIVERSITY is seeking applicants for a tenure-track faculty position in Accounting. Appropriate earned doctorate from an accredited university is required. Will consider those in final stages of dissertation. Winona State University is dedicated to quality classroom instruction. Primary teaching needs are Intermediate and Cost Accounting but will accommodate those with interests in other areas such as Tax, Auditing, and Governmental Accounting. Some evidence of research and prior college level teaching preferred. Professional certification and relevant work experience desirable. Send vita and a list of at least 3 references to: Accounting (TT) Search, Affirmative Action Office, Winona State University, Winona, Minnesota 55987. Open until filled.

#336 OREGON STATE UNIVERSITY has an opening for a tenure-track faculty position at the Assistant/Associate Professor level which will become available during the 1988-89 academic year. Rank is dependent upon qualifications. Preference will be given to candidates in auditing. Responsibilities include quality teaching, research, and professional activities in the field of accounting. Candidates should hold the appropriate doctorate or have substantially completed the degree requirements. Professional certification is desirable. Salary is competitive, fringe benefits are excellent. Candidates should send a letter of application and resumé to: Charles Neyhart, Chairman, Department of Accounting, College of Business, Oregon State University, Corvallis, OR 97331. Applications will be accepted until November 30, 1987. Oregon State University is an Equal Opportunity/Affirmative Action employer.

#337 OLD DOMINION UNIVERSITY—The Accounting Department of the College of Business Administration is seeking applications for an anticipated faculty position in auditing (Assistant Professor preferred). Research and teaching in auditing required. Performance evaluation at Old Dominion University is based upon effective classroom teaching, research and publications, and on university and community service. The accounting program is accredited by the AACSB. The department enjoys a very close relationship with the professional community. Salary and benefits are competitive and dependent upon qualifications. Ph.D. or DBA required (ABD seriously considered). CPA or CIA desirable. Send resumé to Dr. Richard F. Bebee, Chairman, Department of Accounting, College of Business and Public Administration, Old Dominion University, Norfolk, Virginia 23508. Call (804) 440-3529. An Equal Opportunity, Affirmative Action Employer.

#338 NORTHERN ARIZONA UNIVERSITY: Three tenure-track positions at assistant/associate rank. Teach undergraduate and MBA accounting courses. Specialization in tax, auditing, systems or cost/managerial preferred. Ph.D. or DBA and refereed research record required for associate level; ABD considered for assistant level. CPA/CMA desirable. Salary competitive with other AACSB accredited institutions. Positions open until filled. Send resumé and application letter to: Accounting Screening Committee, Box 15066, College of Business Administration, Northern Arizona University, Flagstaff, AZ 86011. NAU is an Equal Opportunity/Affirmative Action Institution. Women and minorities are encouraged to apply.

#339 LOUISIANA TECH UNIVERSITY, Ruston, Louisiana. The School of Professional Accountancy invites applications for faculty positions beginning in the 1988-89 academic year. One position is at a senior rank and requires an individual with an extensive research and publication record and a strong interest in graduate programs. A second position is open for an individual with teaching and research interests in the accounting systems area. One or more additional positions are open for individuals with interests in financial reporting or auditing. All positions require the PhD with professional certification desirable. Contact Dr. James G. Johnston, Director, School of Professional Accountancy, Louisiana Tech University, Ruston, LA 71272. Representatives will be attending the national AAA meeting. Louisiana Tech University is an Affirmative Action employer.

#340 POSITION WANTED IN TAX/LAW/PRINCIPLES OF ACCOUNTING, A.B.D. (Tax), LL.M. (Tax). Five years "Big Eight" experience and eight years teaching experience. Available either in August 1987 or January 1988. Attending AAA convention in Cincinnati in August, 1987. Please write for resumé.

#341 TULANE UNIVERSITY, The A. B. Freeman School of Business is seeking a research-oriented faculty member in financial accounting or managerial accounting to fill a tenure-track position at the level of assistant professor. Salary and benefits are highly competitive. Please send resumé to Soliman Y. Soliman, Ph.D., Area Coordinator, Accounting and Taxation, A. B. Freeman School of Business, Tulane University, New Orleans, Louisiana 70118-5669. An Equal Opportunity/ Affirmative Action Employer.

#342 NEW ZEALAND UNIVERSITY OF CANTERBURY. The Council of the University invites applications for the following position: CHAIR OF ACCOUNTANCY. The successful candidate will have demonstrated academic leadership and possess a record of outstanding research in one or more of the areas of Taxation, Financial Accounting, Management Accounting or Business Finance. The salary for a Professor is within the range of $NZ62,000 to $NZ77,500 per annum. The commencing or subsequent salary may be increased as a result of the review of salaries which the University makes at the beginning of each year. Applications close on 31 August 1987. Further particulars and Conditions of Appointment may be obtained from: The Registrar, University of Canterbury, Private Bag, Christchurch, New Zealand.

#343 THE UNIVERSITY OF ALABAMA School of Accountancy has openings for accounting faculty, beginning as early as January 1988. Applicants will be considered at all ranks. Visiting positions are possible. Applicants should demonstrate potential for quality teaching and research. Enquiries should be sent to Robert W. Ingram, Director, School of Accountancy, Drawer AC, University of Alabama, Tuscaloosa, AL 35487.

#344 DEAN, COLLEGE OF BUSINESS ADMINISTRATION. The Pennsylvania State University invites applications and nominations for the position of Dean, College of Business Administration. We seek a leader who can effectively manage a complex College with faculty at 22 locations. The College offers programs through six academic departments, leading to B.S., M.S., M.B.A., or Ph.D. degrees. Candidates should be able to maintain and develop excellent relationships with the private sector, and be qualified to be a tenured, full professor. Materials should be mailed by September to: Dr. J. D. Hammond, Chair, Business Dean Search Committee, The Pennsylvania State University, 201 Old Main, Box A, University Park, PA 16802. Penn State is an affirmative action, equal opportunity employer.

#345 GEORGE WASHINGTON UNIVERSITY, Department of Accountancy invites applications for tenure-track positions in accounting. Candidates are expected to possess a doctoral degree or be near completion of degree and should be dedicated to teaching excellence and research. GWU is an equal opportunity, affirmative action employer. Please send vita to Dr. Joseph Hilmy, Chairman, Department of Accountancy, George Washington University, 710 21st Street, NW, Room 209, Washington, DC 20052. Telephone (202) 994-6825.

#346 UNIVERSITY OF SOUTHERN CALIFORNIA, School of Accounting is seeking candidates for faculty positions leading to tenure. Faculty positions above the assistant rank are also possible for individuals with strong teaching and publication record. Candidates for assistant professor should have a doctorate in hand or be near completion of the dissertation, strong teaching ability and interest in research. The University of Southern California is an equal opportunity, affirmative action employer. Applications are encouraged from women and minority persons. Please contact Michael Diamond, Associate Dean, School of Accounting, University of Southern California, Los Angeles, California 90089-1421.

An Index to the ACCOUNTING REVIEW 1926–1978

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1917–1925

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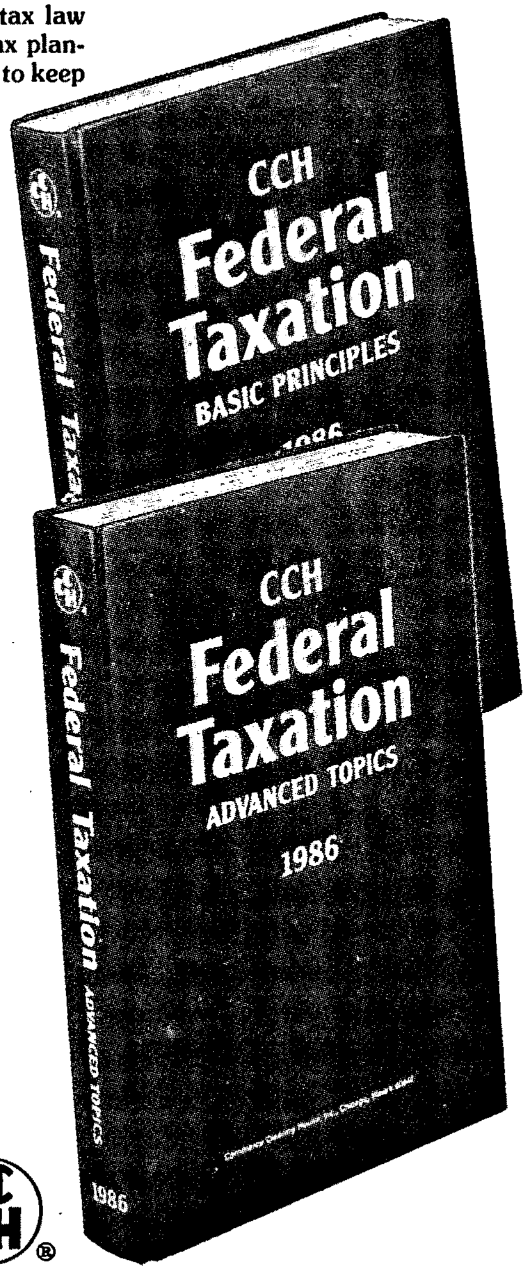

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RESEARCH STUDY #18

TRIPLE-ENTRY BOOKKEEPING AND INCOME MOMENTUM

BY YUJI IJIRI

Is double-entry bookkeeping "absolutely perfect" as it has been claimed? Would it not be possible to extend it logically to triple-entry bookkeeping? If so, what would be the dimension that is destined to become the third dimension in the triple-entry system?

It is trivial to add an arbitrary third dimension and call it triple-entry bookkeeping, since if anything can appear as the third dimension, there is no room for theory, even if the resulting system is useful from a practical standpoint. The essential requirement for a solution to the double-entry problem is, therefore, that the third dimension must be logically deducible from the existing two dimensions (the debit and the credit) of double-entry bookkeeping.

In this publication, the dichotomy of the double-entry bookkeeping system is critically examined to find the logic that binds the existing two dimensions. It is then shown that this dichotomy in the existing system is in fact an imperfect subset of a natural trichotomy upon which a system of triple-entry bookkeeping can be constructed. An examination of this new system, however, reveals that it is deficient in one major aspect. This in turn leads to still a newer type of triple-entry bookkeeping which indeed extends bookkeeping from a two-dimensional space to a three-dimensional space. Some new accounts and new forms of statements are examined along with their implications to financial reporting and accountability. At the end of the publication, it is pointed out that the publication solves only a half of the double-entry problem since there remains another half of double-entry bookkeeping that seems to defy any attempt to extend it logically to a triple-entry system.

"Triple-Entry Bookkeeping and Income Momentum," a fifty-three page publication by Yuji Ijiri, is available to members of the Association for $6.00 per copy and to non-members of the AAA for $9.00 per copy.

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An Analysis of the Impact of State Income Tax Rates and Bases on Foreign Investment
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Accounting Disclosures and the Market's Valuation of Oil and Gas Properties

Trevor S. Harris and James A. Ohlson

ABSTRACT: This paper investigates the explanatory power of various measures that indicate the value of a firm's oil and gas properties. The empirical method relies on cross-sectional valuation models applied over the 1979-83 period. The evidence demonstrates that the primary statements' net book value data are highly significant in explaining the market value of oil and gas properties. This measure dominates the supplementary valuation measures supplied in firms' footnotes, including the "standardized present value" measure. The evidence also clearly shows that the market distinguishes rationally between the successful efforts and the full cost accounting methods.

SFAS No. 19 requires firms in the oil and gas (O&G) industry to disclose supplementary data about their properties. These disclosures supply a relatively rich set of measures that can be used in the valuation of a firm's O&G properties. The measures include: (1) net book value in primary statements as determined by either successful efforts (*SE*) or full costing (*FC*); (2) the standardized measure of discounted future net cash flows relating to proved reserves; (3) the standardized measure of future net cash flows without a discount factor; (4) the current direct profit margin (current sales price minus direct lifting costs, including windfall profit and severance taxes) multiplied by the quantity of proved reserves;[1] and (5) some estimate of the market value of a unit of proved reserves multiplied by the quantity of proved reserves.

The major reason firms' disclosures must go beyond the data in their primary statements appears to have been a perceived inadequacy of historical cost accounting for purposes of evaluating the oil and gas properties. The FASB discussion memorandum [1976] articulates this limitation of GAAP for O&G as follows:

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[1] The standard gas/oil conversion equates 6,000 cf. of gas to one barrel of oil.

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> A major shortcoming in the view of some is that under historical cost accounting the value added as a result of the discovery of mineral reserves is not separately reported when the discovery is made, but is included in income only when the minerals are produced and sold in subsequent years. As a result, under traditional historical cost accounting, there is no basis for evaluating the full results or effectiveness of efforts to find new mineral reserves in the year during which these efforts actually occur. Others suggest that another shortcoming of historical cost accounting in the extractive industries is that a company's major asset, mineral reserves, is not shown at its value in the financial statements. This is not as great a problem in most other industries, where the cost in a transaction is normally considered to be a fair measure of the value received, but it is a problem in the extractive industries, where the costs incurred in the discovery of mineral reserves in most cases are not indicative of a fair measure of the value received [p. 244].

Not surprisingly, over the years many academics have expressed similar concerns (e.g., Welsch and Deakin [1977]).

The existence of several valuation measures of O&G properties raises the issue: How do these valuation measures relate to the *market* value of the O&G properties? Further, as is so frequently argued on *a priori* grounds, to what extent are the (historical cost) book values irrelevant? This paper addresses these questions through an empirical cross-sectional valuation analysis. The dependent variable is the (per equivalent barrel) imputed market value of the properties as inferred from the market value of the equity, and the statistical analysis explains this value in terms of the various valuation measures. Conclusions bear only on the determination of values *within* an industry. This research makes no attempt to identify relevant valuation measures when the market evaluates O&G properties relative to other assets available in the economy.[2]

In spite of the alleged deficiencies of GAAP for O&G properties, the empirical results demonstrate that the O&G book values are highly significant in the valuation model of O&G properties. More generally, the data analysis robustly supports the hypothesis that the book values are relevant, and we have been unable to come up with a plausible confounding variable scenario. The book values are, in fact, no less important than the present value measure. The other three valuation measures—future net cash flows, direct profit margin, and quantity of proved reserves—do not achieve statistical significance when the regression includes book and present values. The results are also consistent with the view that the market rationally perceives that the *SE* method values O&G properties more conservatively than the *FC* method.

In our view, the significant explanatory power of net book values in the valuation of O&G properties has two conceivable explanations.

First, one can hypothesize that the validity of the Paton and Littleton [1940] doctrine "value received equals value surrendered" applies as much to O&G properties as it does to other kinds of assets and liabilities. Consistent with the doctrine and the statistical results, one can further argue that the market places credence in historical cost accounting because of its "objectivity." The relative importance of book values to present values is otherwise difficult to explain.

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[2] Freeman [1983] has stressed that the information content of an accounting disclosure may depend on whether the setting is inter- or intra-industry. In particular, Freeman shows that inter-industry analysis best brings out the information content of SFAS No. 33 data.

Second, one can hypothesize that the market is irrational in its use of financial information, i.e., in this particular case, the market relies "excessively" on data that derive from the primary financial statements. This explanation embraces the spirit of the "functional fixation hypothesis." This hypothesis is less than aesthetically pleasing.

This paper does not attempt to discriminate between the two explanations.

MARKET AND ACCOUNTING MEASURES OF THE VALUE OF OIL AND GAS PROPERTIES

The market's valuation of O&G properties is the dependent variable of interest. Because such properties rarely trade separately, the variable cannot be observed with sufficient frequency as a practical matter. Hence, we use as a proxy the market valuation of firms' equity adjusted for non-O&G assets and liabilities. Thus, the inferred or *imputed* market value of O&G properties is expressed as:

$$\begin{aligned}\text{Imputed Value of O\&G} &= \text{Value of Equity}\\ &\quad + \text{Value of Liabilities}\\ &\quad - \text{Value of Non-O\&G Assets.}\end{aligned}$$

To implement this approach, ideally one should use market values for all the variables on the right-hand side in the equation. Such values are available only for marketable debt and equity. For other debt (primarily current liabilities) and for non-O&G assets, we have used book values. Note that the computation of the imputed market value does not depend on the book value of O&G properties.

Dividing the imputed value of O&G properties by the physical quantity of proved reserves leads to Imputed Value of O&G on a per equivalent barrel (*EQB*) basis:

$$IV \equiv \frac{\text{Imputed Value of O\&G}}{\text{Units of equivalent barrels of proved reserves}}.$$

This approach for measuring the dependent variable was introduced by Miller and Upton [1985a], and has been followed by others (e.g., Magliolo [1986]).[3] The *EQB* normalization deals with the heteroscedasticity problem that would obviously be present otherwise. (See the section titled Multivariate Regression Results.)

The operational definition of the numerator leads to two potential measurement error problems. First, the net book values of tangible non-O&G properties may deviate from their market values. Second, the scheme excludes unrecognized intangible assets such as general goodwill. The first problem appears minor. For our sample, the net book value of O&G properties relative to total assets averages 62 percent (relative to total assets minus current liabilities it is no less than 82 percent). Furthermore, as will be argued in a subsequent section, these measurement errors are not likely to confound the empirical analysis. The second problem, however, is more complex. Off-balance-sheet assets may be important and, at the very least, one should expect that a firm's exploration and development capabilities affect its market value. Again, we defer a discussion to a subsequent section.

The independent variable of primary interest is the (net) book value, or carrying value, of the O&G properties.

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[3] The *IV* variable is of interest to financial analysts. For example, First Boston Corp. tracks this variable for independent O&G companies and supplies the information to their customers. Further, the financial press has regularly reported on *IV* for the major takeovers (e.g., Texaco's acquisition of Getty Oil).

On an *EQB* basis, define

$$BV \equiv \frac{\text{Net Book Value}}{\text{Units of equivalent barrels of proved reserves}}.$$

The book value is affected by the accounting method used for capitalizing exploration costs. Firms use either of two accounting principles: the full costing method ($BV-FC$), or the successful efforts method ($BV-SE$). Each method includes a variety of specific applications. These differ in terms of which costs are capitalized and at what point they are transferred to the cost pools that are subject to amortization. Differential applications may have non-trivial effects, a point considered in SFAS No. 19. Nevertheless, firms rarely describe their application of accounting principles in detail, and the only practical accounting principles distinction is between *SE* and *FC*.

Firms generally disclose net book values in terms of three components: cost of properties that are not currently amortized; cost of properties that are amortized; and accumulated depletion, depreciation, and amortization. Although the correspondence is not exact, costs not subject to amortization reflect exploration expenditures, the success of which have yet to be evaluated ("unevaluated costs"), while costs that amortize have been evaluated. The definition of book value comprises the net of all three components.

The analysis also considers three "current value" measures of the O&G properties as explanatory variables.

First, annual reports disclose the standardized present value of net future cash flows from proved reserves. This disclosure has been a requirement since the SEC issued ASR No. 253 in August 1978. The SEC approach to the present value computation was modified in November 1982; at that time the FASB issued SFAS No. 69, which supersedes ASR No. 253. The major difference between the two documents is that SFAS No. 69 requires the inclusion of an income tax effect in the present value calculation.[4] In both cases the net cash flows must be discounted at ten percent, and the computations generally require an assumption that future selling prices and production costs equal those recently experienced by the firm. Assumptions must also be made about future production patterns. The latter is frequently viewed as particularly arbitrary. It suggests that the present value estimate tends to be partially discretionary, and inter-firm comparisons demand caution. Notation for this variable on an *EQB* basis is:

$$PV \equiv \frac{\text{Present Value of Future Net Cash Flows}}{\text{Units of equivalent barrels of proved reserves}}.$$

Second, firms must disclose net future cash flows derived from proved reserves. This measure relies on the same input as the previous one, except for the discount factor which now equals zero. Notation on an *EQB* basis is:

$$FV \equiv \frac{\text{Net Future Cash Flows}}{\text{Units of equivalent barrels of proved reserves}}.$$

One potential advantage of *FV* relative to *PV* is that inter-firm comparability may be enhanced: the numerator in *FV* depends on fewer assumptions than

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[4] The *PV* variable is before taxes. Due to non-comparable reporting environments, we adjusted the after-tax cases by allocating the discount to tax and non-tax portions. (To adjust from before taxes to after taxes is not generally possible unless one makes assumptions about tax rates.)

PV since future production patterns are irrelevant. On the other hand, insofar as fields have distinct production patterns over time, the value estimate disregards an economically important characteristic. One can further argue that the zero discount rate leads to a measure which is not sufficiently conservative to be realistic. However, even if this were true, the *FV* measure may be superior to the *PV* measure when oil and gas firms are compared to each other, since the zero discount factor "error" may affect firms equally. *FV* therefore may be useful as an intra-industry index of value, although it is possibly useless for inter-industry financial analysis.

Third, the average sales price minus direct lifting costs per barrel produced in the current year serves as an indicator of the per-barrel value of proved reserves. The notation used is:

DP ≡ Direct Profit Margin per Equivalent Barrel in the Current Year.

Firms disclose *DP* information in their 10-Ks (ASR No. 253). The measure has considerable theoretical appeal: the classical valuation theory of extractive resources, generally attributed to Hotelling [1931], suggests that the value of reserves on a unit basis equals *DP*. Although the theory relies on certainty and other stringent assumptions usually encountered in classical models, it is important to note that *future* prices and direct lifting costs do not enter directly into the calculation that determines the value of the reserves. The reason is simply that, in equilibrium, future profit margins increase at the risk-free return rate. Curiously, therefore, under the narrow assumptions used in the Hotelling analysis, the *DP* and the *FV* measures are conceptually identical.[5] A zero discount rate does not distort or bias *FV* because the resulting error is exactly offset by another error: that future selling prices and costs remain the same as those in the current period.

Miller and Upton [1985a] discuss fully the theory due to Hotelling. These authors, [1985a, 1985b], have also tested empirically the extent to which direct profit margin measures explain *IV*. Their findings generally support the hypothesis, and they further suggest that their direct profit margin measure is no less important than *PV*. Miller and Upton did not consider *BV* or *FV* in their analysis.[6,7]

DATA

The initial sample includes all O&G companies that are (1) classified as "independents" in a 1983 industry survey prepared by Arthur Andersen, and (2) that have data available on the COMPUSTAT file. The first criterion eliminates companies with major non-production/exploration activities (in particular, companies with marketing/refining operations). The second criterion was primarily used to assure easy access to a firm's accounting data.

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[5] Of course, the assumptions required for equivalence in *FV* and *DP* are extremely stringent, and as a practical matter differences may be material. *DP* depends only on currently producing properties, while *FV* also depends on properties that will be put into production in future years. Without there being a close relation between the two kinds of properties' extraction costs—which is the case in the "real world"—one cannot expect *DP* to equal *FV*. Further, note that in the "real world" one distinguishes between development costs and lifting costs, a feature which is absent in the Hotelling analysis.

[6] The Miller and Upton [1985a, 1985b] measure of direct profit margin differs from the one used in this study. Miller and Upton derive their measure from Herold's reports. As far as we know, the Herold estimates involve more than simply extracting a specific number from the 10-K report. Herold's direct profit margin measures may, of course, be of better quality than those used in this study. The evidence supports the hypothesis: the $\bar{R}^2$ reported by Miller and Upton generally exceeds ours. However, the two analyses differ in terms of their operational definitions of *IV* and sample, and these factors may also lead to goodness-of-fit differences.

[7] Recent work by Magliolo [1986] extends the Miller-Upton work by measuring firms' tax obligations.

The data for the independent variables —*BV*, *PV*, *FV*, and *DP*—were all derived from firms' 10-Ks and annual reports. Firms' market values (price per share times shares outstanding) were extracted from statistical documents published by *I.P. Sharp* and *Standard and Poor's*. Dates of the market values postdate the fiscal year-ends (FY) by three and one-half months. The delay period ensures with reasonable certitude that the 10-Ks/annual reports had been disseminated prior to the price observations; the market values therefore should impound the information in the 10-Ks /annual reports.

Additional data about the firms' properties were derived from the 10-Ks, annual reports, and Arthur Andersen's annual industry surveys. The Arthur Andersen surveys were also used to check the data prepared.

Data were collected for the period 1979 through 1983—a total of five years. FY 1979 was the first year requiring supplementary disclosures pursuant to ASR No. 253. The end year, 1983, is the last year for which data were available at the time of this study.

Data preparation included a series of reasonableness checks on the basic independent and dependent variables. The primary purpose was to avoid introducing errors due to ambiguous or unusual presentation of the supplementary disclosures. Consistency checks across documents were implemented whenever possible. However, in a few instances no *apparent* error was detectable, yet the valuation measures were clearly unreasonable and did not make economic sense (e.g., a book value of less than ten cents per equivalent barrel). These cases were eliminated from the analysis. Similarly, a few firms with *IV* in excess of $40 were also disregarded. Under no circumstances were observations deleted because of a perceived exceptional relation between dependent and independent variables, or among the independent variables. Thus, the statistical analysis should be without biases. The elimination procedure does imply, however, that the population for which the inferences and conclusions apply excludes outliers.[8]

The number of sample firms through the years 1979 to 1983 varies from 49 to 62 for a total of 283 data points. Table 1 displays the number of data points available for each variable and year. The table also partitions the data on *SE* vs. *FC* and *OTC* vs. NYSE/AMEX. Note that some firms had only partial supplementary disclosures in 1979. The number of useful data points therefore is frequently less than 283. All five variables are available for 272 observations.

DESCRIPTIVE STATISTICS

Table 2 provides distributional statistics for the five basic variables partitioning the data on year and *SE/FC*. The statistics conform to our prior expectations. First, the independent variables tend to increase over time, reflecting the escalation in exploration costs and energy prices that generally prevailed throughout the period. The 1981 decline in *IV*, however, is due to the market's reduced expectations of the rate of increase in energy prices, and in that year the market values of O&G stocks declined. Second, note that for each year the median $BV-SE$ is less than the median $BV-FC$, a relation that one

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[8] Observations were dropped for the following reasons. Due to a low *BV*: one (1979); due to a high *IV*: ten (two in 1979, three in 1980, one in 1981, two in 1982, two in 1983). Retaining the outliers does not affect any major conclusions.

TABLE 1

DATA AVAILABILITY—NUMBER OF FIRMS, BY YEAR, ACCOUNTING METHOD, AND EXCHANGE

	Year					Method		Exchange		
Variable	*1979*	*1980*	*1981*	*1982*	*1983*	SE	FC	OTC	*NYSE/ AMEX*	*Total*
BV	49	54	59	62	59	104	179	100	183	283
PV	44	54	59	62	59	102	176	99	179	278
FV	42	54	59	62	59	101	175	97	179	276
DP	49	54	59	62	59	104	179	100	183	283

BV=Net book value per equivalent barrel.
PV=Present value of future cash flows per equivalent barrel.
FV=Value of undiscounted future cash flows per equivalent barrel.
DP=Direct profit margin per equivalent barrel.
SE=Successful efforts accounting method.
FC=Full costing accounting method.
OTC=Over the Counter.
NYSE/AMEX=New York Stock Exchange or American Stock Exchange.

should expect since *FC* is a less conservative accounting method than *SE*. No other variable displays a similarly strong dominance pattern when partitioned on *SE/FC*. On the other hand, the differences between $BV-FC$ and $BV-SE$ are not overwhelming since, for each year, the lower 25 percent-quartile of *FC* roughly equals the median of *SE*, and the 75 percent-quartile of *SE* roughly equals the median of *FC*. Perhaps more striking are the large cross-sectional ranges of *BV* for a given year and accounting method. This variability raises a question that will be addressed: Do these differentials reflect economic realities or accounting idiosyncrasies? Third, for any given year, note that $\text{median}(BV) < \text{median}(PV) < \text{median}(FV) \sim \text{median}(DP)$. The first inequality reflects the relatively conservative valuation of historical cost accounting, the second inequality follows trivially, and the third (approximate) equality conforms with the discussion in the first section.

Table 3 provides information about the pairwise correlations for the dependent and independent variables for the five years partitioned on *SE* and *FC*. Averaged over the five years, these coefficients are all positive, which supports the proposition that each of the four valuation measures can serve as indicators of the per equivalent barrel market value of the O&G properties.[9] The different independent variables do not, however, work equally well in explaining *IV*, and the results in Table 3 convey three distinct impressions. First, the book value measures do better than any of the other measures. Second, the correlation between *IV* and *BV* appears to be particularly strong for *SE* firms. Third, the *PV* variable is the second best in explaining *IV*, and it is distinctly better than *FV* and *DP*.

Table 4 provides greater detail about the relation between *IV* (dependent variable), and, respectively, *BV*, *PV*, and *DP* (independent variables) using a simple regression framework. Results show

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[9] Consistent with the results in Dharan [1984], further analysis shows that any two of the independent variables generally explain the third one.

TABLE 2

UNIVARIATE STATISTICS

Characteristics		IV					BV					PV					DP					FV				
		1979	*1980*	*1981*	*1982*	*1983*	*1979*	*1980*	*1981*	*1982*	*1983*	*1979*	*1980*	*1981*	*1982*	*1983*	*1979*	*1980*	*1981*	*1982*	*1983*	*1979*	*1980*	*1981*	*1982*	*1983*
90%	*SE*	14.84	27.33	14.68	11.42	14.01	3.06	3.71	7.48	9.97	7.48	10.09	12.05	12.15	12.07	11.61	12.38	19.43	19.92	18.39	19.06	16.83	22.44	25.37	18.78	17.94
	FC	11.92	25.51	15.43	13.24	13.48	5.36	7.05	9.28	11.65	11.93	10.82	11.36	13.40	13.58	12.03	9.79	16.72	18.94	22.39	21.42	14.89	20.28	24.16	23.63	21.61
75%	*SE*	10.80	20.26	10.51	8.77	9.87	2.80	3.45	4.94	6.12	5.91	7.52	10.16	11.40	11.30	11.03	9.65	13.70	17.50	16.34	17.54	14.73	15.79	18.54	17.76	16.57
	FC	10.20	16.11	10.98	8.58	8.72	4.10	5.13	6.92	9.06	7.10	7.99	9.48	10.91	11.44	10.68	9.44	13.60	17.03	18.20	18.76	11.66	16.16	18.44	18.29	16.57
50%	*SE*	6.76	13.33	6.76	7.19	7.22	1.97	2.55	3.26	3.91	5.03	6.34	8.28	10.24	10.20	9.41	8.47	11.19	13.85	15.24	15.63	10.65	13.80	15.72	16.19	14.96
	FC	8.16	10.46	7.14	6.59	6.85	2.80	3.26	4.68	6.09	5.47	5.92	7.28	8.75	8.94	8.02	8.46	11.58	14.81	15.80	16.55	9.73	12.74	15.83	15.97	14.85
25%	*SE*	4.28	9.00	4.73	4.47	5.23	1.38	2.00	2.72	3.16	3.39	4.31	5.98	7.24	7.52	6.91	7.82	10.05	11.22	12.09	14.47	8.23	11.47	14.82	14.46	14.07
	FC	5.26	5.92	5.02	4.28	4.94	2.02	2.51	3.10	3.30	3.68	4.15	5.34	6.60	7.24	6.40	6.95	9.31	11.20	13.58	14.36	7.76	10.76	12.78	14.29	12.90
10%	*SE*	1.80	5.33	3.16	3.57	3.72	1.11	1.27	1.54	1.66	1.93	3.59	3.39	6.49	6.76	6.46	6.70	9.08	8.80	10.09	13.73	5.80	7.70	13.18	14.27	12.40
	FC	2.60	4.17	2.81	3.06	3.10	1.71	1.19	2.32	2.90	2.89	3.50	4.03	4.85	4.84	4.92	4.14	6.93	9.64	11.44	11.77	6.16	9.53	10.13	11.44	6.43
N-SE		21	20	22	20	21	21	20	22	20	21	19	20	22	20	21	21	20	22	20	21	18	20	22	20	21
N-FC		28	34	37	42	38	28	34	37	42	38	25	34	37	41	38	28	34	37	42	38	24	34	37	42	38

IV=Imputed market value of oil and gas properties.
BV=Net book value per equivalent barrel.
PV=Present value of future cash flows per equivalent barrel.
DP=Direct profit margin per equivalent barrel.
FV=Value of undiscounted future cash flows per equivalent barrel.
SE=Successful efforts accounting method.
FC=Full costing accounting method.
N=Number of observations.

TABLE 3

SUMMARY OF SIMPLE CORRELATION COEFFICIENTS FOR THE BASIC VARIABLES

	IV	BV	PV	FV	DP
I. *Successful Efforts Firms*					
IV	1	.763* (.900, .711)**	.625 (.709, .480)	.408 (.601, .060)	.426 (.646, .204)
BV		1	.582 (.696, .467)	.339 (.638, .140)	.355 (.733, −.130)
PV			1	.653 (.824, .340)	.389 (.800, .137)
FV				1	.407 (.623, .197)
DP					1
II. *Full Costing Firms*					
IV	1	.636 (.740, .535)	.556 (.728, .298)	.463 (.578, .305)	.414 (.576, .277)
BV		1	.504 (.637, .337)	.437 (.547, .297)	.356 (.549, .071)
PV			1	.762 (.882, .675)	.660 (.753, .566)
FV				1	.614 (.718, .515)
DP					1

IV=Imputed market value of oil and gas properties.
BV=Net book value per equivalent barrel.
PV=Present value of future cash flows per equivalent barrel.
FV=Value of undiscounted future cash flows per equivalent barrel.
DP=Direct profit margin per equivalent barrel.
*=Average over five years.
**=First entry: maximum; second entry: minimum.

that the *BV* variable is highly significant in all years, for both *SE* and *FC* firms. While *PV* is also highly significant, $\bar{R}^2(IV, BV)$ exceeds $\bar{R}^2(IV, PV)$ in nine cases out of the ten. Table 4 also details the previously observed relatively low explanatory power of *DP*. (The order of magnitude is about the same for *FV*.) Note that the regression coefficients' magnitudes are greater for *BV−SE* compared to those for *BV−FC*. Such a relation is generally consistent with the notion that *SE* is a more conservative accounting method than *FC*. But it may also be due to limitations inherent in simple univariate regression analysis. The next section extends the analysis to a multivariate framework.

MULTIVARIATE REGRESSION RESULTS

We consider the following model to estimate the relation between the dependent variable and the explanatory variables.

$$\tilde{IV}_{jt} = \alpha_t + \sum_{k=(1,5)} \beta_{kt} x_{kjt} + \tilde{\epsilon}_{jt}$$

TABLE 4
REGRESSION RESULTS ON INDIVIDUAL INDEPENDENT VARIABLES
DEPENDENT VARIABLES: *IV-SE* AND *IV-FC*

	1979	*1980*	*1981*	*1982*	*1983*
BV-SE					
α	−0.53	3.31	2.71	1.68	1.58
	(−0.25)	(1.27)	(2.09)	(2.24)	(1.12)
β	4.14	4.19	7.34	1.17	1.35
	(4.41)	(4.81)	(4.57)	(8.74)	(4.85)
$\bar{R}^2$	0.48	0.54	0.49	0.80	0.53
N	21	20	22	20	21
BV-FC					
α	3.74	3.46	3.01	1.68	2.26
	(2.86)	(1.48)	(2.18)	(1.89)	(2.46)
β	1.24	2.31	1.04	0.84	0.85
	(3.23)	(4.13)	(4.27)	(6.96)	(6.35)
$\bar{R}^2$	0.26	0.33	0.32	0.54	0.52
N	28	34	37	42	38
PV-SE					
α	−1.44	2.64	1.22	−3.71	−3.34
	(−0.57)	(0.66)	(0.43)	(−1.16)	(−1.27)
β	1.49	1.49	0.72	1.15	1.23
	(3.97)	(3.17)	(2.45)	(3.54)	(4.38)
$\bar{R}^2$	0.45	0.32	0.19	0.38	0.47
N	19	20	22	20	21
PV-FC					
α	5.70	2.61	0.56	−0.20	0.66
	(3.59)	(0.82)	(0.35)	(−0.18)	(0.41)
β	0.34	1.25	0.88	0.77	0.81
	(1.50)	(3.19)	(5.25)	(6.64)	(4.47)
$\bar{R}^2$	0.05	0.22	0.42	0.52	0.34
N	25	34	37	41	38
DP-SE					
α	4.29	9.84	0.45	−4.49	−4.97
	(1.02)	(1.76)	(0.16)	(−1.33)	(−1.01)
β	0.41	0.39	0.53	0.82	0.81
	(0.91)	(0.89)	(2.74)	(3.59)	(2.89)
$\bar{R}^2$	−0.01	−0.01	0.24	0.38	0.27
N	21	20	22	20	21

TABLE 4—*Continued*

	1979	*1980*	*1981*	*1982*	*1983*
DP-FC					
α	4.02	6.05	3.22	−1.35	−2.68
	(1.81)	(1.55)	(1.28)	(−0.69)	(−1.07)
β	0.43	0.51	0.35	0.53	0.62
	(1.67)	(1.63)	(2.11)	(4.46)	(4.16)
$\bar{R}^2$	0.06	0.05	0.09	0.31	0.31
N	28	34	37	42	38

IV=Imputed market value of oil and gas properties.
BV=Net book value per equivalent barrel.
PV=Present value of future cash flows per equivalent barrel.
DP=Direct profit margin per equivalent barrel.
SE=Successful efforts accounting method.
FC=Full costing accounting method.
N=Number of observations.
t-statistics are in parentheses

where the j and t subscripts denote firms and years, respectively. Further,

$$x_{1jt} = \begin{cases} BV & \text{if the firm uses the } SE \text{ method,} \\ 0 & \text{otherwise;} \end{cases}$$

$$x_{2jt} = \begin{cases} BV & \text{if the firm uses the } FC \text{ method,} \\ 0 & \text{otherwise;} \end{cases}$$

x_{3jt}, x_{4jt}, x_{5jt}=PV, DP, FV,

ϵ_{jt}=cross-sectionally uncorrelated disturbance terms with a fixed variance for each year, and

$\alpha_t\{\beta_{kt}\}_{k,t}$ denote the parameters to be estimated.

This model calls for several comments. First, the model distinguishes between $BV-SE$ and $BV-FC$. This makes economic sense since the market presumably appreciates that SE is distinctly more conservative than FC. Presuming that the BV variables are indicators of value, one should expect $\hat{\beta}_{1t}$ to exceed $\hat{\beta}_{2t}$. Second, the EQB normalization in the valuation measures and the dependent variable follows naturally as the result of an undeflated regression model which has been adjusted to deal with heteroscedasticity.[10] Third, because of changing industry conditions, the regression coefficients may vary over time. The more bullish the market's expectations, the greater the β-coefficients. Significant inter-temporal variation in estimated regression coefficients therefore should not be viewed as a sign of model misspecification since the valuation is one of intra-industry at a specific date. Fourth, a zero $\bar{R}^2$ admits a straightforward interpretation: while the market relies on the quantity of proved reserves to assess the value of a firm's O&G properties, it disregards the other valuation measures. This hypothesis should not be considered totally implausible, as it holds if the market perceives a unit of

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[10] More specifically, let EQB denote proved reserves and consider the cross-sectional model

$$\tilde{IV} \times EQB = \alpha EQB + \beta_1 BV - SE \times EQB + \beta_2 BV - FC \times EQB + \beta_3 PV \times EQB + \beta_4 DP \times EQB + \beta_5 FV \times EQB + \tilde{\nu}$$

where Var $[\tilde{\nu}]^{1/2}$ = const × EQB. Dividing by EQB on both sides leads to the model specified in the text. Note that the parameter α reflects the market's use of proved reserves in valuing the O&G properties.

The EQB-normalized independent variables have almost no correlation with (the inverse of) EQB. Hence, the regression model's independent variables do not surrogate for firms' size.

TABLE 5

REGRESSION RESULTS: SUCCESSFUL EFFORTS AND FULL COSTING FIRMS POOLED

Dependent Variable	*Intercept* $\hat{\alpha}_t$	BV-SE $\hat{\beta}_{1t}$	BV-FC $\hat{\beta}_{2t}$	PV $\hat{\beta}_{3t}$	DP $\hat{\beta}_{4t}$	$\bar{R}^2$	SSE	N
IV-79	−0.15 (−0.07)	2.41 (3.53)	1.29 (3.00)	0.45 (2.00)	0.09 (0.38)	0.36	420	44
IV-80	−1.41 (−0.52)	3.40 (4.62)	1.90 (4.11)	0.65 (1.88)	0.13 (0.56)	0.47	1450	54
IV-81	−0.65 (−0.41)	0.84 (3.08)	0.72 (3.71)	0.49 (2.87)	0.06 (0.55)	0.47	514	59
IV-82	−1.40 (−1.26)	0.82 (5.71)	0.49 (4.50)	0.31 (2.25)	0.14 (1.44)	0.67	230	61
IV-83	−1.82 (−1.06)	0.93 (4.25)	0.63 (4.43)	0.24 (1.29)	0.20 (1.53)	0.56	317	59

IV=Imputed market value of oil and gas properties.
BV=Net book value per equivalent barrel.
PV=Present value of future cash flows per equivalent barrel.
DP=Direct profit margin per equivalent barrel.
SE=Successful efforts accounting method.
FC=Full costing accounting method.
N=Number of observations.
SSE=Sum of squared errors.
Numbers in parentheses are *t*-statistics.

proved reserves as homogeneous across properties. (Articles in the business press dealing with corporate acquisitions in the O&G industry at least implicitly tend to treat properties as homogeneous.) Non-zero regression coefficients (β_{kt}) explain *differential unit values* at a particular date. Factors such as location, quality, production costs, tax obligations, etc., presumably cause these value differentials.

Table 5 provides results for the estimated valuation model with *BV−SE*, *BV−FC*, *PV*, and *DP* as independent variables. Inclusion of *FV* in the model has virtually no impact, and to keep matters simple, the reported results exclude this variable. The goodness of fit is significant, with the $\bar{R}^2$ ranging from a low of .36 to a high of .67. Consistent with the results in Table 4, the book value measures are highly significant in all years. (The smallest *t*-value is 3.00.) The *PV* variable, however, does not achieve significance in one year (1983), and the *t*-value is approximately two in one additional year (1980). The *DP* variable is clearly insignificant in all years. We retain *DP* only because it has a central place in the Miller-Upton studies.[11]

To describe the relative contributions of the explanatory variables, one can compare the decreases in the $\bar{R}^2$ that follows from deletions of, respectively,

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[11] We also estimated a model that pools the data over the five years and with dummy intercept variables for year effects. The estimates (and *t*-statistics) for $\hat{\beta}_1, \ldots, \hat{\beta}_5$ are, respectively: 1.05 (6.74), 0.69 (6.50), 0.51 (3.88), .04 (0.52), and .05 (0.65). The $\bar{R}^2$ equals .51. The model does not appear to be well specified, however. Equivalence in β-coefficients over the years can be rejected at less than the .05 level. Nevertheless, the result reaffirms the significance of the *BV* and *PV* variables, and the insignificance of the *DP* and *FV* variables.

TABLE 6

SUCCESSFUL EFFORTS AND FULL COSTING COMPANIES: A COMPARISON OF RELATED STATISTICS

	1979	*1980*	*1981*	*1982*	*1983*
1. β_1/β_2 in Regression Models (Table 5)	1.85	1.80	1.15	1.66	1.46
2. Median(*BV–FC*)/median(*BV–SE*)	1.42	1.27	1.43	1.56	1.09
3. Mean(*BV–FC*)/mean(*BV–SE*)	1.50	1.39	1.32	1.35	1.30
4. Line 1/Line 3 (theoretical value = 1)	1.23	1.29	0.87	1.22	1.22

BV = Net book value per equivalent barrel.
SE = Successful efforts accounting method.
FC = Full costing accounting method.

BV (−*SE* and −*FC*) and *PV* in each regression model. The result is unambiguous: for all five years the $\bar{R}^2$ decreases more if one deletes *BV* (−*SE* and −*FC*). This conclusion remains whether or not the regression includes *DP* and/or *FV*. Overall, the results definitely convey the impression that historical cost information dominates the supplementary information in explaining the market value of O&G properties.

Consistent with Table 4, Table 5 also reveals $\hat{\beta}_{1t}$ exceeds $\hat{\beta}_{2t}$ in all years. It is particularly noteworthy that the order of magnitude of $\hat{\beta}_{1t}/\hat{\beta}_{2t}$ roughly corresponds to that of median(*BV*−*SE*)/median(*BV*−*FC*), since the latter ratio indicates the degree to which *SE* is a more conservative accounting method than *FC*. Table 6 summarizes the different ratios, including mean(*BV*−*SE*)/mean(*BV*−*FC*). On a more formal level, the hypothesis that $\beta_{1t} = \beta_{2t}$ can be rejected at the .04 level or better for all years except 1981. The joint hypothesis $\beta_{1t} = \beta_{2t}$, $T = 1979, \ldots, 1983$ can be reject- at the .01 level. These results lend considerable credence to the valuation model and the relevance of book value information in explaining the imputed market value.

The intercepts in the Table 5 regressions are all negative and statistically insignificant. This finding, taken at face value, suggests that the market does not rely on quantity of proved reserves when valuation measures are available. (Recall that the regression model normalizes all variables for *EQB*, and hence the undeflated constant relates to proved reserves.) Of course, this conclusion may be particularly sensitive to model specification, and it should be interpreted cautiously.

One can hypothesize that *SE* and *FC* firms differ in their type of operations and risk characteristics, and that this omitted variable drives some of the previous results. To deal with this problem, it is useful to estimate the valuation model separately for *SE* and *FC* firms. The scheme also serves two other purposes. First, if in fact the market extracts important economic information from the book values, then the coefficient associated with *SE* should exceed that of *FC* in a variety of estimation contexts. Thus, it is probably more demanding to

TABLE 7

REGRESSION RESULTS: SUCCESSFUL EFFORTS AND FULL COSTING FIRMS RUN SEPARATELY

Dependent Variable	*Intercept* $\hat{\alpha}_t$	BV-SE $\hat{\beta}_{1t}$	BV-FC $\hat{\beta}_{2t}$	PV $\hat{\beta}_{3t}$	DP $\hat{\beta}_{4t}$	$\bar{R}^2$	SSE	N
IV-79-SE	−7.82 (−2.36)	3.12 (3.31)	—	0.88 (2.53)	0.43 (1.51)	0.65	143	19
IV-79-FC	3.93 (1.59)	—	0.90 (1.85)	0.21 (0.75)	−0.03 (−0.08)	0.10	185	25
IV-80-SE	−1.60 (−0.34)	3.37 (3.12)	—	0.57 (1.17)	0.21 (0.70)	0.54	386	20
IV-80-FC	−1.09 (−0.30)	—	1.86 (3.11)	0.85 (1.43)	−0.01 (−0.03)	0.39	1057	34
IV-81-SE	−1.90 (−0.65)	0.98 (2.69)	—	0.22 (0.84)	0.28 (1.63)	0.52	132	22
IV-81-FC	0.83 (0.42)	—	0.57 (2.25)	0.79 (3.37)	−0.16 (−0.98)	0.49	336	37
IV-82-SE	−0.32 (−0.15)	1.05 (5.67)	—	0.17 (0.53)	0.06 (0.27)	0.79	46	20
IV-82-FC	−1.3 (−0.99)	—	0.39 (2.72)	0.39 (2.36)	0.13 (1.18)	0.60	175	41
IV-83-SE	−0.54 (−0.13)	0.99 (2.26)	—	0.71 (1.88)	−0.17 (−0.49)	0.56	94	21
IV-83-FC	−2.07 (−1.04)	—	0.65 (3.99)	0.10 (0.46)	0.29 (1.88)	0.57	208	38

IV=Imputed market value of oil and gas properties.
BV=Net book value per equivalent barrel.
PV=Present value of future cash flows per equivalent barrel.
DP=Direct profit margin per equivalent barrel.
SE=Successful efforts accounting method.
FC=Full costing accounting method.
N=Number of observations.
SSE=Sum of squared errors.
Numbers in parentheses are *t*-statistics.

demonstrate that $\hat{\beta}_{1t}$ exceeds $\hat{\beta}_{2t}$ when separate regression models estimate the coefficients.[12] Second, the model bears on whether the market views *SE* as a more informative accounting method compared to *FC*. A survey by Naggar [1978] finds that the great majority of financial analysts prefer *SE* to *FC*. The results in Table 7 produce no surprises. The coefficients $\hat{\beta}_{1t}$ and $\hat{\beta}_{2t}$ remain roughly the same as in Table 5, and $\hat{\beta}_{1t} > \hat{\beta}_{2t}$, for all years. Further, the $\bar{R}^2$ are greater for *SE* firms than for *FC* firms, except for 1983 in which case they are almost identical.[13] Additional analysis also shows that the *BV−SE* variables' contribution to $\bar{R}^2$, given *PV* and *DP*, exceeds those of $BV-FC$, for all five years. We interpret these results as being consistent with the Naggar survey about the two accounting methods' relative usefulness.

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[12] The procedure controls for any potential omitted variables due to non-random choice of accounting method. (See, for example, Deakin [1979] and Lilien and Pastena [1982] for empirical analyses of *SE* firms vs. *FC* firms.)

[13] Of course, this $\bar{R}^2$ comparison presumes that *FC* and *SE* firms differ only by their accounting methods. Thus, we view the *FC* and *SE* valuation observations as drawings from a homogeneous population.

In sum, the regressions show the following:

1. Book value measures are highly significant in explaining the imputed value of O&G properties. The result obtains even though the regressions include three alternative valuation measures. This suggests that the market views the book value of O&G properties as capturing value-relevant information.
2. The market clearly distinguishes in a rational fashion between the *SE* and *FC* methods.
3. Although the present value measure achieves some statistical significance, the book values—at least weakly—dominate the supplementary valuation measures.
4. Neither the direct profit margin nor the undiscounted future cash flows attain statistical significance in regressions that also include the book value and present value measures.
5. The proved reserves quantity does not contribute to the explanation of the imputed market value when the book value and present value measures are available.
6. Consistent with survey findings, the book value measure has greater explanatory power for *SE* firms than *FC* firms.

DISCUSSION OF RESULTS AND THE ISSUE OF CONFOUNDING VARIABLES

The results raise the fundamental question of why the book value measures are relevant in the valuation of O&G properties. The issue is particularly intriguing since the regressions include three alternative valuation measures; the large and consistent explanatory power of $BV-SE$ and $BV-FC$ in the regressions is perhaps puzzling in view of the literature's mostly negative comments about O&G accounting principles. To address the economic relevance of the book value measures, we first consider the reasons for variation in BV, and then evaluate how these factors affect the regression coefficients $\hat{\beta}_{1t}$ and $\hat{\beta}_{2t}$. We believe that the following exhaustively lists the factors that make BV vary across firms.

1. *The Accounting Method that Values the Oil and Gas Properties*

As previously indicated, the matter goes beyond the *SE* and *FC* distinction. The cost pool identification is more on a continuum than two distinct methods. In application, examples of possible cost pools are (1) the acquisition unit (*SE*), (2) the natural geological unit (*SE*), (3) the geopolitical unit (*FC*), and (4) the firm as a whole (*FC*). Other variations relate to the accounting for pre-evaluation costs and under what circumstances capitalized costs start to deplete. Each accounting implementation results in a more or less conservative procedure valuing the oil and gas properties.

2. *Uncertainty With Respect to Proved Reserves*

The denominator of BV relies on *proved* reserves of oil and gas. This estimate should be distinguished from the less conservative *probable* reserves. Accordingly, firms frequently revise estimated proved reserves due to improved geological data [Welsch and Deakin, 1977]. Particularly tenuous are the reserve estimates for recently discovered fields. Important geological data about a field's total size does not become available until production has begun. In a rough sense, the expectation of post-production geological data is that proved reserves should be revised upwards to conform more closely to previously estimated probable reserves. Given that reserves must be proved rather than probable to enter into the denominator of *BV*, one can hypothesize that firms with a high proportion of recently discovered fields have relatively large *BV*. One may further hypothesize that some firms deliberately use more (or less) conservative definitions as to what constitutes proved reserves.

3. *Discovery and Development Capability*

Some firms may have superior capabilities in finding and developing O&G properties. Firms with superior capabilities experience proportionally fewer dry wells or incur less expenditures in developing productive wells. Both of these factors are potentially significant in explaining differential *BV* for *FC* firms. The effects should be of less importance for *SE* firms; these firms expense unsuccessful exploration expenditures independently of the success rate so the skill factor reduces to differential development expenditures.

4. *The Luck Factor in Finding Oil and Gas*

In explaining differential *BV*, this source applies only to firms using the *FC* method. Mitigating against the significance of luck is the averaging effect that follows from multiple exploration efforts. Indeed, this averaging effect is an often-used argument in favor of the *FC* method.

5. *Proportion of Costs that Reflect Unevaluated Properties*

Firms neither expense (*SE*) nor deplete (*FC*) exploration costs prior to an evaluation of the effort's success. These unevaluated costs are part of the numerator in the computation of *BV*, yet do not enter into the denominator. Accordingly, under either accounting method, firms with a high proportion of unevaluated costs relative to the (net) book value of all properties should have a relatively large *BV*.

6. *Proportion of Reserves that are Purchased Reserves*

BV increases to the extent that a firm purchases reserves rather than acquires them through exploration. Since *SE* is more conservative than *FC*, and the unit cost of purchased reserves generally should exceed *BV−FC*, this purchase effect should be greater on *SE* firms.[14]

7. *Properties' Average Age and Changes in Exploration Costs*

Exploration costs per physical unit discovered generally change with the passage of time due to (1) (industry-specific) inflation, (2) the necessity of incrementally moving exploration and drilling efforts to more hostile environments, and (3) innovations that improve on existing exploration/development technologies. Given the price trends in 1979–83, one should expect firms with a high proportion of recently discovered reserves to have a correspondingly large *BV*. For both *FC* and *SE* firms, Table 2 shows that *BV* tends to increase with time. Further, because of inflation, firms with a high proportion of gas properties should have lower *BV*, since gas properties last longer than oil properties.

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[14] Note that in the long run, under steady price/cost conditions the unit purchase cost should be greater than the unit *FC* book value due to (1) risk in exploration, and (2) unrecognized interest costs on pre-discovery expenditures.

8. *Value Received Approximates Value Surrendered*

This equivalence concept is important and it may be summarized by "you get what you pay for." *BV* may be a poor approximation of the market value per unit of proved reserves in absolute terms, but, for a given accounting method, this does not rule out the possibility that *BV* can be a useful intra-industry index. A variety of economic reasons suggest that the unit value of some proved reserves may be greater than that of others. On the revenue side, factors such as location and quality lead to differential unit prices at the wellhead (e.g., crude oils differ in their viscosity, lightness, and sourness). On the expense side, fields may differ in their lifting costs depending upon location and the required technology to recover the deposit (e.g., onshore vs. offshore fields). And the greater the proportion of required development expenditures incurred, the greater the value of the properties. Future revenues and costs are also affected by differential taxation and other kinds of governmental expropriation of property rights (e.g., the dichotomy between "old" vs. "new" oil, and the regulation of interstate natural gas prices). The net of future revenues minus future production and development costs should have a positive correlation with *BV* in a predictable environment. This is simply a matter of equilibrium since the total expected discounted net cash flows must be the same for all exploration prospects in the same risk class. Thus, relatively high expected future net cash flows must be offset by relatively high past incurrence of acquisition, exploration, and development expenditures.

9. *Proportion of Gas Properties Relative to Oil*

The denominator in *BV* uses the "standard" conversion factor that equates six *mcf* of gas to one barrel of oil. (The conversion factor derives from equivalence in energy [BTU] units.) However, such a factor may not reconcile with economic realities, and it is frequently suggested that the relative market values should be in the neighborhood of a ten to one ratio. If one additionally invokes the "you get what you pay for" doctrine, then a relatively large *BV* may reflect a high proportion of gas properties.[15]

How do these factors influence the estimated *BV* regression coefficients? Out of the nine factors, six—1, 2, 4, 6, 7, and 9—would seem to garble the information content of the *BV* variables, and, accordingly, lessen the chances of finding significant $\hat{\beta}_{1t}$ and $\hat{\beta}_{2t}$ coefficients. Indeed, points 1, 4, 6, and 7 re-express well-known arguments against the relevance of GAAP when valuing O&G properties. Similarly, unevaluated properties (point 5) are of only limited importance because the percentage of total book value that relates to unevaluated/non-producing properties is usually small.[16,17] Only two possibilities remain to be considered: differential discovery/development capabilities (3), and "you get what you pay for" (8). The first of these two factors should lead to *negative* $\hat{\beta}_{1t}$ and $\hat{\beta}_{2t}$ coefficients, even in the absence of the other valuation measures. (Under extreme conditions, one can argue that *BV* serves as a perfect negative indicator of management capabilities, and that the measure conveys no other information.)

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[15] We reran regressions using a ten to one rather than six to one conversion factor. This had no significant impact on the results.

[16] Unfortunately, a systematic analysis is difficult if not impossible because (1) some firms do not separate O&G book value into the two components evaluated/unevaluated properties, and (2) the meaning (accounting treatment) of unevaluated (or unamortized) properties appears to differ across firms.

[17] Herold's appraised values of non-producing properties on the average constitutes a small proportion of total appraised value.

Thus, we conclude that "value surrendered approximates value acquired" best explains the regression results. The relative "objectivity" of historical cost accounting measures is evidently more important than the anticipatory but "subjective" supplementary disclosures. Barring the existence of omitted/confounding variables, or market irrationality, we can think of no other scenario explaining the regression results.

As an alternative to the above interpretation, one could try to identify confounding variables whose (possibly hypothetical) inclusion in the regressions would change the estimated coefficients —$\hat{\beta}_{1t}, \ldots, \hat{\beta}_{5t}$. In that case, the distinctive feature of the $\{x_{kjt}\}_{k=1,\ldots,5}$ variables is their correlation with variables that the market in fact uses in valuing O&G firms. (In the extreme, such variables may make *BV* irrelevant.) Unfortunately, absent the "right" model and data for hypothetically relevant omitted variables, the analysis becomes somewhat speculative.

A closely related issue considers whether measurement errors in the independent variables explain the regression results. The market may perceive errors in the *PV*, *DP*, and *FV* variables "as reported," and their usefulness depends on appropriate "corrections." The scenario cannot, of course, be tested without knowledge about these "corrections." Nevertheless, the discussion in Miller and Upton [1985a] indicates that Herold's valuation analyses ("appraised values") derive from numerous supplementary disclosures as well as fairly complex data manipulations. Herold's valuation procedures are proprietary, and his use of historical cost is not publicly known.[18] The empirical results need to be qualified insofar as the market relies on valuation measures that are complex composites of the supplementary disclosures. Even so, the qualification relates to the usefulness of supplementary disclosures, and the elimination of *BV* variables requires a much stronger condition: the "corrections" do not rely directly on *BV* yet the "corrections" must correlate with *BV*. In our view, this hypothesis has only limited plausibility.

Another issue concerns measurement errors in the dependent variable, and the extent to which its errors might correlate with the independent variables. The measurement errors in question are of two kinds. First, the calculation of *IV* uses book values rather than market values for non-O&G assets (and some liabilities). Second, the calculation assigns zero value to goodwill. With respect to the first issue, we see no reason why the differences between market values and book values should correlate with any of the independent variables in the regression models.[19] Most non-O&G assets and non-market-value liabilities refer to working capital, which involves few controversial items. The second issue, however, cannot be dismissed as easily: positive goodwill might reflect aggressive exploration efforts that allow a firm to increase its proved reserves. To the extent exploration costs per unit discovered increase over time, one should expect firms with large *BV* to have positive goodwill; thus, *IV* and *BV* would correlate positively. We test this hypothesis by including percentage of reserves added in the current year as another variable in the regression equation. The results, which we do not report, show that the percentage of reserves added variable has no significant impact in any year. This result is not the only negative finding. While the scenario presented might have some validity for the ebullient 1979–80 years, the contrary applies for the more bearish 1982–83 years. Hence, unlike the regression results in Table 5, one should expect *BV* to be more significant in the earlier years than in the later ones. Again, the evidence does not support this explanation.

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[18] Further, as Miller and Upton [1985a] point out, it is not known to what extent Herold relies on the firms' market values to compute appraised values.

[19] One can investigate this matter by checking whether firms with a high proportion of O&G assets relative to total assets yield different results than those with a low proportion. We found no significant differences.

Finally, one can hypothesize that other accounting attributes explain *IV*. We tried two in conjunction with the valuation measures: leverage and net profit per equivalent barrel of proved reserves. Neither variable was significant. But the profit measure at least had the correct sign in each of the five years.

CONCLUDING REMARKS

It is important to appreciate that the findings in this research depend on a particular information content research paradigm, namely, an intra-industry cross-sectional valuation analysis. A change in paradigm might well yield quite different insights. Two aspects of this problem come to mind. First, an inter-industry analysis introduces a different perspective, and within this context the supplementary valuation measures could become more relevant. Freeman's [1983] analysis of SFAS No. 33 data suggest such a possibility. He shows that the supplementary (earnings) disclosures best explain industry effects, while historical cost (earnings) data best explain firm-specific effects. Research about O&G valuation measures along these lines would seem quite feasible and interesting. Second, a price change (or returns) analysis may also lead to different conclusions.[20] However, this research mode poses considerable difficulties unless one develops credible expectations models of the explanatory variables. Given the problem of evaluating the explanatory power of several indicators of unit value, we believe that the cross-sectional valuation paradigm used has comparatively attractive and powerful characteristics.

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[20] Bell [1983] and Bell, Boatsman, and Dhaliwal [1985] analyze the impact of supplementary disclosures on returns at the time of the *initial* disclosures. Bell [1983] identifies a positive market reaction to the initial disclosure of supplementary information. Bell et al. [1985] extend this analysis by comparing it to the market reaction associated with (historical cost) earnings. They find that the reaction to the supplementary data is at least as great. Results of these two papers are not directly comparable to those presented here. Nevertheless, there is broad consistency in the sense that the results suggest that both supplementary and primary statements contain valuation relevant information.

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An Analysis of the Impact of State Income Tax Rates and Bases on Foreign Investment

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ABSTRACT: This study investigates the influence of both the state corporate income tax rate and the form of the income tax base structure on foreign investment in manufacturing assets. An econometric model of foreign investment is derived from a supply-oriented theory of regional investment. That is, the decision to develop productive capacity in one region as opposed to another is due to regional advantages. Empirical results suggest that tax structures that use the unitary method of accounting have a substantial impact on the amounts of foreign investment. On the other hand, business income tax rates appear to have little impact.

A RESEARCH question with important policy implications is whether firms' investment decisions in a state are sensitive to business tax rates and/or the required tax accounting methods (e.g., unitary tax structures). As an illustration, consider a state that seeks to attract investment. If investment decisions are sensitive to tax rate and/or accounting methods, then the state government may wish to offer either favorable tax rates or accounting methods, or both, as a means of attracting investment. On the other hand, if investments are sensitive to neither tax rates nor accounting methods, the state government may wish to offer other investment incentives such as bond financing or capital acquisition loans.

The question addressed is also of interest from a general research perspective. Since the pioneering work of Hall and Jorgenson [1967], there is a body of empirical research that has established that federal tax policy can have an influence on real investment. A strong test of whether tax policy (through tax rates and accounting methods) can have such an impact is to examine the issue at the state tax level, since state taxes are typically

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small in amount relative to federal taxes and relative to the firm's total outlays.

Little is known about the impact of state taxes on business investment decisions. Previous studies on the effects of corporate income tax rates have produced conflicting results. A number of attitudinal studies conclude that business tax rates have important economic consequences. For example, in a survey of U.S. executives performed by Belknap Data Solutions Limited for *Fortune* [1977], 20 percent of the respondents cited state and/or local taxes on business and industry as one of the three to five most important factors in choosing a location. A survey by Tong and Walter [1980] indicated that executives of foreign firms located in the United States ranked state and local tax rates 15th and 16th, respectively, in importance out of 32 important factors of locational choice. A study of Japanese executives [Nihon Keizai Shimbun, 1981] reported that business taxes, and particularly business taxes in states with a unitary tax structure, were very important factors in location choice. Unfortunately, attitudinal studies are of questionable value due to problems of response bias and measurement error.

A study of state economic growth [U.S. Joint Economic Committee Staff, 1981] concluded that lower personal and corporate income tax rates are associated with higher growth rates. On the other hand, numerous studies cited in Due [1961] and Carlton [1979, 1983] have concluded that corporate income tax rates do not explain interregional differences in investment. These studies examined statutory marginal income tax rates and did not investigate tax structures. In fact, with the exception of a survey by Nihon Keizai Shimbun [1981] and a study by Swenson and Moore [1987], there is an absence of survey or empirical studies on the effects of the unitary tax structure on investment decisions.

The purpose of this study is to empirically investigate the validity of two propositions. The first proposition is that there is a negative relation between the total business tax rate and the level of foreign investment. The second proposition is that the method a state uses to measure the income tax base, particularly unitary tax structures, negatively affects foreign investment.

The analysis uses an econometric model to examine the investment decisions of foreign firms. The use of economic theory (of location choice and regional growth) to underpin our econometric model allows for a meaningful test of our hypotheses about the effects of tax rates and tax accounting methods on real investment.

We examine foreign direct investment since there are no data after 1976 on domestic firms' investments by state. While the results of this study may not be generalizable to domestic firms, there is no compelling evidence to indicate that they are not. Foreign firms are rational and as such should behave according to general principles of economics; see for example Hartman [1984, 1985], Goulder, Shoven, and Whalley [1983], and Stevens [1972], who model foreign firms' investment in the United States. Furthermore, foreign investment is significant in amount. In 1981, such investment was 25 percent of the total net plant and equipment expenditures in the United States [Hartman, 1984].

The paper is organized as follows. The next section discusses the various methods of measuring income for purposes of the state corporate income tax base, the unitary tax, and the possible impacts of the unitary tax. A discussion of regional investment models follows. This discussion then serves as a basis for the econometric model presented in the fifth section. The fourth section discusses the data used to estimate the econometric model.

STATE INCOME TAXES

In the 46 states that impose a state corporate income tax, there are several different ways to measure a corporation's income for that purpose. Some states permit separate accounting, whereby income subject to state taxes is measured using conventional accounting allocations and intercompany pricing. However, most states do not permit separate accounting to determine the income from sources within the taxing state, and instead require that income of a corporation be apportioned to the taxing state based on a three-factor formula: the ratio of sales, payroll, and property within the taxing state to the corporation's total sales, payroll, and property. That is, if a corporation has operations in a state, income taxable in the apportioning state will be the firm's total income (both within and outside the state) multiplied by the apportionment formula.

The Unitary Tax

Of the states that require apportionment of a corporation's income, some apply the unitary method to determine the extent to which a corporation's branches and affiliates are included in apportionable income and in a three-factor apportionment formula. The so-called unitary tax defines apportionable income and includes in the apportionment formula income from operations considered to be part of a unitary business of the corporation operating in its state. The basic characteristics of a unitary business are (1) that the corporation's operations are dependent upon or contribute to the business conducted by the group, and (2) that there is at least a 50 percent common ownership or control between the corporation and the corporate group.

The conventional definition of a unitary tax state is one that requires filing of a combined (consolidated) corporate income tax return that includes affiliates considered to be part of the unitary business. Two general types of combinations apply to foreign firms: worldwide and domestic.[1] In worldwide combination, all affiliates, regardless of the place of incorporation, including the foreign parent's foreign subsidiaries, are included in the apportionable base. Domestic combination requires inclusion of affiliates that are incorporated in the United States, regardless of where they do business. Appendix A shows the unitary status of states in our sample from 1977–81 (for more discussion of the unitary tax, see Hellerstein [1983]).

The Impact of the Unitary Tax

Because of the required inclusion of income of affiliates outside the state in the determination of taxable income, the unitary tax effectively expands the income tax base of a corporation *vis-a-vis* the tax base used by other methods of income taxation, such as separate accounting. Whether this expansion results in a larger income tax than would be paid under a nonunitary system depends on a number of factors, including the difference in actual and apportioned income.

The potential impact of a unitary tax may be especially important for new business investment. When a firm locates in a nonunitary state, it is not subject to income taxes in that state until it realizes profits, typically after a period of start-up losses. By contrast, a new firm locating in a unitary state may be subject to taxes on profits apportioned to that state regardless of start-up losses. Thus, unitary taxes actually paid may be substantially greater than they would have been in a nonunitary state, even though a unitary state may have a lower overall business tax rate.

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[1] Three other types of unitary structures are possible: domestic worldwide, domestic water's edge, and nexus. Domestic worldwide applies to U.S. corporations. Nexus includes only those affiliated corporations that are either domiciled within the state or derive income from sources within the state. This is a very restricted form of combination; it applies only in the event of two foreign affiliates doing business within the same unitary state. Water's edge domestic requires inclusion of affiliates in the consolidated return only to the extent that they did business in the United States.

In addition to the tax burden on a start-up operation locating in a unitary state, there also may be a substantial compliance burden for a geographically diversified firm. Financial statements that conform to the unitary state's accounting principles must be prepared. Under all unitary tax structures, financial statements of affiliates that are part of a unitary business must conform to the state's accounting principles. In addition, under a worldwide unitary tax structure, foreign affiliate financial statements must be expressed in U.S. dollars. These costs can be significant; c.f. Tannenwald [1984]. A final cost of the unitary tax may be long-run; Petersen [1976] argues that foreign multinationals' comparative advantages are at risk when sensitive information is disclosed in worldwide combined returns.

In summary, the special accounting methods required by unitary tax structures may decrease investment in unitary states because of decreased after-tax returns and because of increased risk. Decreased returns may be both direct (expansion of the tax base) and indirect (additional accounting costs). We would expect this return and risk influence to be stronger under a worldwide unitary structure than under domestic unitary structures because of the expanded tax base, increased compliance costs, and risk of disclosing information on foreign affiliates.

Models of Regional Investment

Crow [1979] argues that demand-driven regional investment models derived from macroeconomic theory are inappropriate. Instead, he suggests that the decision to invest in a region be viewed as a two-step process. The first is the decision to commit funds to capital formation, a decision handled best by macroeconomic concepts such as the marginal efficiency of capital, the marginal cost of funds, and the accelerator principle. The second is the allocation of these funds to particular regions.

One reason for regarding regional investment as a two-step process is that interest rates and other financial variables are determined in national and international markets where there are few effective restrictions on the interregional mobility of capital. Consequently, allocation of investment to particular regions appears to be irrelevant to capital formation decisions. A second reason is that the applicability of the accelerator principle to regional investment decisions is highly questionable since national capacity, not regional capacity, is generally of concern. Finally, given the mobility of technology and capital in the United States, it appears that the decision to develop productive capacity in one region as opposed to another must be due to regional advantages. This emphasis on regional advantage in attracting investment is consistent with the existence of regional development associations that offer incentives to attract investment.

The proposed model emphasizes a supply-oriented economic theory for regional investment rather than an aggregate-demand theory. As a result, the regional investment model is similar in spirit to locational choice models [e.g., Carlton, 1979, 1983] since the decision to invest in one region as opposed to another is due to regional advantages. That is,

$$y_i = h(\chi_i) + \omega_i \qquad (1)$$

where y_i is the amount of investment (positive and negative) in region i; χ_i is a q-dimensional vector of exogenous variables such as factor costs, taxes, business climate, and agglomeration economics [McCall and Pascal, 1979]; $h(\bullet)$ is an unknown functional form; and ω_i is a random disturbance. *A priori*, a multiplicative or log-log specification for $h(\bullet)$ is preferred, because unlike a linear specification, it implies constant elasticity of substitution.

DATA

We use data on net foreign investment in gross manufacturing assets by state for the period 1977–81 as a dependent variable and state-specific economic variables for the same period as independent variables. The analysis is restricted to foreign investment in manufacturing assets since investment in certain assets such as mining is not determined by regional economic characteristics, but is tied to their location by supply and demand factors. Similarly, merchandisers are excluded because they may locate in an area based on market demand rather than factor costs.

Foreign investment data were obtained from the U.S. Department of Commerce publications, referenced in Appendix B. While data are available for five industry groups for manufacturers, these industry group data are rendered relatively useless because approximately 30 percent of the data is not disaggregated by the Department of Commerce.[2] Alaska and Hawaii are eliminated from the analysis because they are atypical of the other 48 states. Wyoming is eliminated because foreign investment was made by so few investors that disaggregated data could not be obtained.[3]

The independent variables in our study are 15 state-specific attributes expected to affect local factor costs and factor supply. Data sources for the 15 variables appear in Appendix B. Five of the independent variables were used by Carlton [1979, 1983] to model locational choices of firms across SMSAs. These variables are electricity prices, natural gas prices, unemployment rates, manufacturing wage rates, and a business climate index.[4] Other explanatory variables used in our study, but not in the Carlton study, include population as a measure of agglomeration economics [Moomaw, 1983], four variables affecting the availability of transportation, and two variables measuring climate.[5]

In addition to these 12 variables, three tax variables are used. Prior studies [e.g., Carlton, 1983] have not considered a unitary variable but have examined statutory marginal tax rates. In accordance with our discussion in the second section concerning the unitary tax, we consider two forms of the unitary tax, worldwide and domestic, as separate explanatory variables in addition to nonunitary structures. An additional tax variable considered is the average effective corporate income tax rates. As discussed in Fullerton [1984], effective marginal tax rates are more appropriate than nominal marginal tax rates since the latter do not consider the effects of varying exemptions and credits. Although effective marginal tax rates are the theoretically appropriate measure in the context of investment decisions, the aggregate data available in our study do not enable us to calculate expected profitability and tax by type of foreign investment for each state.[6] Accordingly, we use the average effective corporate income tax rate, defined as:

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[2] To protect the identity of individual companies, the Department of Commerce does not report disaggregated data if more than 80 percent of the investment is made by two or fewer investors.

[3] Ibid.

[4] The business climate index was constructed using the same method as described in Carlton [1979, 1983].

[5] The agglomeration effect is that costs of specialized factor inputs should be lower in highly populated areas. Access to and costs of supplies, as well as product shipping costs, are expected to be more favorable in an area with good transportation facilities than in an area with poor facilities. Climate variables are used to control for the rapid growth of sun belt states.

$$CTR_{st} = CT_{st}/BI_{st} \tag{2}$$

where CTR_{st} is the average effective corporate income tax rate in state s in year t, CT_{st} are corporate income taxes attributable to manufacturing in state s for year t, and BI_{st} is business income accruing to the manufacturing sector in state s in year t. Estimated business income and taxes attributable to manufacturing are calculated using the procedure discussed in Appendix C. Calculated tax rates appear in Appendix D.[7] We exclude other taxes from the numerator for the following reasons. Sales and use taxes are excluded since the legal liability for such taxes can vary widely from state to state and the business portion of such taxes may be impossible to determine [Wheaton, 1983]. Of the remaining business taxes, only real property taxes are substantial in amount [Wheaton, 1983]; we exclude real estate taxes because new businesses are often given full or partial tax relief that may result in zero or very low rates and because property taxes are tied directly to benefit levels and usually do not represent out-of-pocket costs [Fullerton, 1984].

ECONOMETRIC MODEL

Unfortunately, the correct model specification of (1) is unknown. As a consequence, the modeling process must resolve two interrelated problems: the selection of a set of explanatory variables and the choice of a functional form. As shown by Mizon [1977], the choice of a functional form has important implications for subsequent statistical tests.

Therefore, the strategy adopted here was to calculate the all 2^{15} possible regressions equations for the linear and log-log functional forms of (1). Equations clearly inconsistent with the data were rejected; those consistent with the data were retained for further analysis. The determination of consistency was made on the basis of Mallow's C_p statistic [Draper and Smith, 1981]. Graphical analysis and the goodness-of-fit statistics confirm that the multiplicative or log-log specification appears to be appropriate for the data.[8]

The model resulting from the above strategy is

$$\begin{aligned} \ell n(y_i) = \beta_0 + \beta_1 BCI_i + \beta_2 POP_i \\ + \beta_3 UNEM_i + \beta_4 CTR_i \\ + \beta_5 UWW_i + \beta_6 UD_i + \epsilon_i \end{aligned} \tag{3}$$

where BCI is the business climate index, POP is the natural logarithm of population, $UNEM$ is the natural logarithm of the unemployment rate, CTR is the natural logarithm of the average effective corporate income tax rate, UWW is an indicator variable denoting states with a worldwide unitary tax structure, and *UD* is an indicator denoting states with a domestic unitary tax structure. Although the variable *CTR* is not statistically significant, it has been included in the model because of its theoretical importance. Estimated coefficients, summary statistics, and *p*-values for *t*-statistics are reported in Table 1. Regression diagnostics such as Cook's distance and graphical analysis confirmed the appropriateness of these models for the period 1977–81. For example, all of Cook's distances are well within the ten percent ellipsoid. In other words, the coefficients of the model as reported in Table 1 are not unduly influenced by any one state.

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[6] The Department of Commerce data report only total foreign assets and payroll investments by state.

[7] The estimation procedure was necessary since business income by state and by sector was last published by the Department of Commerce in 1977. Although published *GSP* (and business income) estimates are available for at least one of the years in the period 1977–81 for 18 states, we have used only our *GSP* estimates because a combination of our estimates and published state estimates might induce additional measurement error into the data.

[8] As a further confirmation of the appropriateness of the log-log functional form, the Godfrey-Wickens [1981] test was used to determine the adequacy of the linear and log-log forms against the more general Box-Cox regression model. The results confirmed the appropriateness of the log-linear form given by (3).

Since the estimated coefficients on the indicator variable can be distorted by the proxy variable problem, reverse regression was used as a diagnostic check of the potential seriousness of this distortion. This diagnostic check provided further confirmation of the strength of the signal being sent by the two indicator variables.[9] The reverse regressions also indicated that omitted variables bias is not significant. Furthermore, as shown in Table 2, the correlations among the estimated regression coefficients do not suggest that multicollinearity is a problem.[10] Of particular interest here is the fact that the correlations between the estimated coefficients for the two unitary tax variables and the estimated coefficient for corporate income tax variables are very small.[11]

The effects of agglomeration economics, as measured by population, exert a strong influence on the amount of foreign investment, although states with the largest population do not necessarily have the largest investment. Unemployment was statistically significant at the 0.05 level in 1977 and 1978. The poor performance of this variable for 1979–81 may reflect the beginning of an economic recession in the United States. The positive sign on unemployment is in accordance with our *a priori* expectations, since, especially for large firms, a high unemployment rate may reduce the cost of assembling and maintaining a work force. The performance of business climate is relatively stable through the five-year time horizon being examined. Diagnostic checks on the linear effect implied by this index were performed and confirmed the appropriateness of this index.

The corporate income tax rate was not significant for any of the five years. The insignificance of the average effective corporate income tax variable may be due to the fact that it is only a proxy for the marginal effective rate. On the other hand, previous studies examining the effects of statutory marginal corporate

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[9] The reverse regression models for (3) are

$$Q_i = \alpha_0 + \alpha_1 \ell n(y)_i + \alpha_2 UWW_i + \eta_i$$

and

$$Q_i' = \alpha_0' + \alpha_1' \ell n(y)_i + \alpha_2' UD_i + \eta_i'$$

where

$$\begin{aligned} Q_i = {} & \hat{\beta}_0 + \hat{\beta}_1 BCI_i + \hat{\beta}_2 POP_i + \hat{\beta}_3 UNEM_i \\ & + \hat{\beta}_4 CTR_i + \hat{\beta}_6 UD_i \end{aligned}$$

and

$$\begin{aligned} Q_i' = {} & \hat{\beta}_0 + \hat{\beta}_1 BCI_i + \hat{\beta}_2 POP_i + \hat{\beta}_3 UNEM_i \\ & + \hat{\beta}_4 CTR_i + \hat{\beta}_5 UWW_i \end{aligned}$$

$\hat{\alpha}_2$ and $\hat{\alpha}_2'$ are the reverse regression coefficients on the indicator variables. Following the arguments of Leamer [1978] and Conway and Roberts [1983], it is our opinion that the estimated coefficients $\hat{\beta}_5$ and $\hat{\beta}_6$ in (3) have sensible interpretations only when their reverse regression estimates given by $-\hat{\alpha}_2/\hat{\alpha}_1$ and $-\hat{\alpha}_2'/\hat{\alpha}_1'$ are approximately equal to the direct estimates reported in Table 1. In other words, the proxy variable problem does not distort the interpretation of the estimated coefficient when this condition is satisfied.

[10] An eigen-analysis of the cross-product matrix of the independent variables confirms that extent of multicollinearity in the data is small.

[11] Since the corporate income tax rate measures a rate effect and the unitary tax variable represents a base effect, we would expect the correlation between them to be relatively small.

TABLE 1

ESTIMATED REGRESSION EQUATIONS

$$\ell n(y)=\beta_0+\beta_1 BCI+\beta_2 POP+\beta_3 UNEM+\beta_4 CTR+\beta_5 UWW+\beta_6 UD+\epsilon$$

	1977			*1978*			*1979*			*1980*			*1981*		
Parameter	*Estimate*	*t-statistic*	p(t)*	*Estimate*	*t-statistic*	p(t)	*Estimate*	*t-statistic*	p(t)	*Estimate*	*t-statistic*	p(t)	*Coefficient*	*t-statistic*	p(t)
Constant	−5.04	−4.96	.00	−4.38	−4.99	.00	−4.03	−4.78	.00	−3.30	−3.64	.00	−2.98	−2.61	.01
Business Climate (*BCI*)	0.08	2.19	.03	0.06	1.77	.08	0.06	1.75	.09	0.05	1.33	.19	0.09	1.81	.08
ℓn Population (*POP*)	1.09	11.06	.00	1.06	10.66	.00	1.09	11.79	.00	1.03	11.87	.00	1.01	8.48	.00
ℓn Unemployment (*UNEM*)	0.84	2.01	.05	0.80	1.91	.06	0.54	1.42	.16	0.49	1.21	.23	0.41	0.88	.38
ℓn Corporate Income Tax Rate (*CTR*)	−0.06	−0.74	.54	−0.03	−0.42	.68	−0.02	−0.25	.80	−0.01	−0.15	.88	−0.02	−0.18	.86
Unitary Tax-Worldwide Structure (*UWW*)	−0.58	−2.41	.02	−0.58	−2.64	.01	−0.52	−2.01	.05	−0.50	−1.85	.07	−0.51	−1.56	.13
Unitary Tax-Domestic Structure (*UD*)	−0.47	−1.85	.07	−0.42	−1.70	.10	−0.48	−2.07	.04	−0.49	−2.20	.03	−0.49	−2.30	.03
R^2	0.80			0.81			0.83			0.82			0.77		
Standard Error of the Estimate	0.63			0.61			0.56			0.54			0.67		

* Two-sided

TABLE 2
CORRELATIONS BETWEEN REGRESSION COEFFICIENTS IN TABLE 1

	BCI	POP	UNEM	CTR	UWW	UD
1977						
Constant	−0.28	−0.58	−0.62	0.21	−0.12	−0.19
BCI		−0.07	0.16	0.01	0.06	0.12
POP			−0.24	0.05	0.06	−0.07
UNEM				−0.31	0.04	0.23
CTR					−0.11	−0.18
UWW						0.16
1978						
Constant	−0.12	−0.60	−0.50	0.19	−0.08	−0.17
BCI		−0.13	−0.01	−0.04	0.06	0.12
POP			−0.34	0.07	0.08	−0.11
UNEM				−0.30	−0.06	0.24
CTR					−0.07	−0.16
UWW						0.13
1979						
Constant	−0.13	−0.62	−0.53	0.17	−0.11	−0.18
BCI		−0.17	0.03	−0.04	0.09	0.07
POP			−0.28	0.09	0.05	−0.11
UNEM				−0.30	0.01	0.28
CTR					−0.11	−0.17
UWW						0.15
1980						
Constant	−0.11	−0.49	−0.67	0.24	−0.09	−0.25
BCI		−0.18	0.01	−0.10	−0.03	0.05
POP			−0.26	0.07	0.07	−0.11
UNEM				−0.29	0.02	0.32
CTR					−0.11	−0.20
UWW						0.14
1981						
Constant	−0.14	−0.56	−0.58	0.20	−0.03	−0.27
BCI		−0.18	−0.01	−0.09	−0.19	0.16
POP			−0.27	0.06	−0.01	−0.08
UNEM				−0.27	0.07	0.29
CTR					−0.10	−0.21
UWW						0.12

BCI = Business Climate
POP = *ℓn*(Population)
UNEM = *ℓn*(Unemployment)
CTR = *ℓn*(Corporate Income Tax Rate)
UWW = Unitary Tax-Worldwide Structure
UD = Unitary Tax-Domestic Structure

income tax rates [Due, 1961; Carlton, 1983] on location choice also concluded that income taxes using this measure were insignificant. This may indicate that state corporate income tax rates *per se* are not important at the margin.[12]

With the exception of 1981, the coefficients on the indicator variable denoting states with a worldwide unitary tax structure are statistically significant at the 0.10 level. Furthermore, with the exception of 1978, the coefficients on the indicator variable denoting states with a domestic unitary tax structure are statistically significant at the 0.10 level. The coefficients on these two indicator variables suggest that the presence of a unitary tax structure lowered investment by amounts varying from 34 percent to 44 percent. A single indicator variable reflecting states with either a worldwide or domestic unitary tax structure was also substituted for *UUW* and *UD* in (3). The coefficient on this variable was statistically significant at the 0.10 level for all five years.[13]

CONCLUSIONS

Results of this study indicate that agglomeration economics, business climate, and the presence or absence of unitary tax structures are important determinants of foreign manufacturers' investment decisions. On the other hand, the weak relation of various measures of the corporate income tax rate suggests that it is not an important determinant. The weak corporate income tax rate relation is consistent with previous studies, e.g., Due [1961] and Carlton [1979, 1983].

The substantial impact of unitary tax accounting estimated by our econometric model is a function of at least two economic costs: tax burden and tax compliance burden. For example, the effective tax burden on a new firm in a state with a unitary tax structure can be extremely large when compared to the tax burden of an equivalent firm not subject to this tax structure. This can occur because a new firm classified as a unitary business is taxed not only on profits it generates but also on profits generated by its affiliates. On the other hand, an equivalent firm not subject to the effects of the unitary structure is taxed only on profits it generates. In some cases, a new firm with operating losses may pay income taxes under a unitary tax structure because of profits generated by its affiliates, whereas an equivalent firm under a nonunitary tax structure would not pay any income taxes.[14] A worldwide unitary structure may result in a significant tax compliance burden for geographically diversified firms. Financial statements from worldwide operations must conform to that state's unitary accounting system and these statements must be translated into U.S. dollars.

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[12] In an attempt at construct validation, we used three additional definitions of the tax variable: (1) change in corporate tax rates divided by the change in corporate income (a proxy for the marginal income tax rate on new investment), (2) all taxes (property, income, payroll, and licenses/fees) paid by manufacturers divided by total stock of manufacturing investment (a proxy for average effective tax rates on investment), and (3) statutory marginal corporate income tax rates. None of the three definitions proved to be statistically significant.

[13] Because it is difficult to classify New York as a unitary or nonunitary state, both classifications were used. The coefficients were found to be insensitive to either classification. For the results reported in Table 1, New York is classified as a unitary state.

[14] The aggressiveness of the compliance and collection arm of the state tax boards may have an incremental influence in unitary states. California and New York are known to aggressively enforce tax compliance and collection.

APPENDIX A

UNITARY STATUS OF THE STATES IN THE SAMPLE, 1977–1981

State	Applicable State Law Section Number	Nonunitary*	Unitary	
			World-wide	Domestic
Alabama	40-18-2	X		
Arizona	43-1111	X		
Arkansas	84-2003	X		
California	23151; 23501		X	
Colorado	39-22-301			X
Connecticut	12-214	X		
Delaware	1902	X		
Florida	220.02	X		
Georgia	91A-3602	X		
Idaho	63-3025		X	
Illinois	201			X
Indiana	6-3-2-1	X		
Iowa	422.33	X		
Kansas	79-32, 110			X
Kentucky	141.040	X		
Louisiana	31	X		
Maine	5102(b), (8)	X		
Maryland	288(b); 316	X		
Massachusetts	2; 39			X
Michigan	208.31	X		
Minnesota	290.02, 03	X		
Mississippi	27-7-5	X		
Missouri	143.441	X		
Montana	15-31-401			X
Nebraska	21-306			X
Nevada	No state income tax	X		
New Hampshire	239-A: 139	X		
New Jersey	54:10A-2; 54:10E-2	X		
New Mexico	7-2A-3	X		
New York	209			X**
North Carolina	105-130.3	X		
North Dakota	57-38-30		X	
Ohio	5733.01	X		
Oklahoma	2355	X		
Oregon	317; 318.020		X	
Pennsylvania	402	X		
Rhode Island	44-11-1	X		
South Carolina	12-7-230	X		
South Dakota	No state income tax	X		
Tennessee	67-2702	X		
Texas	No state income tax	X		
Utah	59-13-3; 59-13-65			X
Vermont	5832	X		
Virginia	58-151.03	X		
Washington	No state income tax	X		
West Virginia	4	X		
Wisconsin	71.01	X		

* Nonunitary states include states without a corporate income tax, states using separate accounting, states with unitary rules only affecting domestic corporations, and states with unitary taxation applying only to "nonbusiness" income (e.g., dividends received).

** Although limited by statute in its combined reporting requirements, New York may have been a *de facto* unitary state due to regulations and their judicial support.

APPENDIX B
DATA SOURCES

Independent Variables (Data by State)	*Reference*
1. Electricity Prices*	*Typical Electric Bills* Federal Power Commission (1977-1981)
2. Natural Gas Prices*	*Gas Facts*, American Gas Association (1977-1981)
3. Unemployment Rate	*Statistical Abstract of the United States* (1984)
4. Number of Airports	*Statistical Handbook of Aviation*, Federal Aeronautics Administration (1977-81)
5. Railroad Miles	*Book of Railroad Facts*, American Railroad Association (1977-81)
6. Port Facilities	*Waterborne Commerce of the U.S.*, U.S. Army Corps of Engineers, 1979.
7. Roadways	*Highway Statistics*, U.S. Federal Highway Administration (1977-81)
8. Average Number of Days Sunshine	*Statistical Abstract of the United States*
9. Average Number of Heating Days	*Statistical Abstract of the United States*
10. Manufacturing Wage Rate*	*Statistical Abstract of the United States*
11. Business Tax Rate a. Employment by state and industry *Supplement to Employment and Earnings, States and Areas, Data for 1977-81.* U.S. Department of Labor, Bureau of Labor Statistics, 1982. b. Business taxes, except payroll and property. *State Government Tax Collections*, Department of Commerce, 1977-82. c. Business taxes, payroll and property. *State Government Finance (1977-1982)*, U.S. Department of Commerce. d. National income accounts. "Input-output Structure of the U.S.," *Survey of Current Business*, November 1984.	Appendix C
12. Business Climate Variable	Footnote 4
13. Population	*Statistical Abstract of the United States*
14. Worldwide Unitary Variable	Appendix A
15. Domestic Unitary Variable	Appendix A

Dependent Variable	
Foreign Investment into the United States**	*Foreign Direct Investment in the United States: Operations of U.S. Affiliates, 1977-1980*, U.S. Department of Commerce, Bureau of Economic Analysis, Washington, D.C., 1985. *Foreign Direct Investment in the United States: Annual Survey Results, Revised 1981 Estimates*, U.S. Department of Commerce, Bureau of Economic Analysis, 1984.

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* Deflated using the consumer price index with 1977 as the base year.

** Deflated using GNP implicit price deflator with 1977 as the base year.

APPENDIX C

PROCEDURE FOR CALCULATING BUSINESS INCOME BY STATE

"Business income" is the portion of the state's value added accruing to business (as opposed to labor) in that year. A necessary first step in calculating business income is to calculate estimated gross state product for the state for that year. Gross state product (*GSP*) was estimated using national income account data by industry [Kendrick and Jaycox, 1965]. The procedure is as follows.

Gross state product for each industry is calculated as follows:

$$SVA_{s,j}=E_{s,j}\times NVA_{n,j}/E_{n,j} \tag{A.1}$$

$$GSP_s=\sum_j SVA_{s,j} \tag{A.2}$$

$$YB_s=GSP_s-P_s \tag{A.3}$$

where $SVA_{s,j}$ is the state value added for industry j in the state s, $E_{s,j}$ is the total employment for industry j in the state s, $NVA_{n,j}$ is the national value added originating in industry j, $E_{n,j}$ is the total national employment for industry j, *GSP* is total gross state product of state s, YB_s is business income in state s, and P_s is total state payroll in state s.

Note that total state payroll (A.3) is estimated from the national employment data by using the payroll value-added ratios from the national income accounts. Both deflated and current *GSP* were calculated. In the case of current dollar calculations, the *GSP* formula in (A.2) was adjusted by inflating value-added (by industry) by price adjustments (in that industry). For manufacturing industries, price adjustments were calculated by movement (for that particular good/service if published) in the consumer-producer price indices. Where possible (estimated *GSP* was published for 18 states at some time during 1977-81) calculated *GSP* was validated against *GSP* estimates published by states. From (A.3), business income for manufacturing was derived by subtracting payroll for the manufacturing sector from estimated value added in the manufacturing sector. Corporate income taxes attributable to manufacturing are computed by multiplying total corporate tax collections by the ratio of manufacturing income to total income for each state.

Data sources for the preceding calculations were from the following:

1. Employment by state and industry.
   Supplement to Employment and Earnings, States and Areas, Data for 1977-81. U.S. Department of Labor, Bureau of Labor Statistics, 1982.
2. Business taxes, except payroll and property.
   State Government Tax Collections, Department of Commerce, 1977-82.
3. Business taxes, payroll and property.
   State Government Finance (*1977-1982*), U.S. Department of Commerce.
4. National income accounts.
   "Input-output Structure of the U.S.," *Survey of Current Business,* November 1984.

APPENDIX D

AVERAGE EFFECTIVE STATE CORPORATE INCOME TAX RATES

Average effective state corporate income tax rates for manufacturing are listed below for the 47 states included in this study. These rates are the ratio of corporate income taxes to estimated income accruing to manufacturing.

	Tax Rate (Percent)				
State	*1977*	*1978*	*1979*	*1980*	*1981*
Alabama	0.36	0.56	0.62	0.62	0.51
Arizona	1.10	1.10	1.31	1.56	1.49
Arkansas	1.28	1.43	1.32	1.20	1.07
California	1.99	2.17	2.11	2.01	1.97
Colorado	1.07	0.97	1.09	0.93	0.73
Connecticut	2.66	2.33	2.41	2.28	2.19
Delaware	1.72	2.25	2.41	1.74	1.29
Florida	1.07	1.22	1.27	1.35	1.27
Georgia	1.04	1.09	1.07	1.01	0.95
Idaho	1.32	1.23	1.32	1.25	1.35
Illinois	1.10	1.09	1.14	1.75	1.71
Indiana	0.56	1.15	0.68	0.93	0.88
Iowa	1.06	1.13	1.23	1.25	1.17
Kansas	1.72	1.68	1.65	1.54	1.34
Kentucky	1.45	1.37	1.51	1.38	1.23
Louisiana	0.65	1.11	1.12	1.12	1.02
Maine	1.55	1.36	1.46	1.46	1.17
Maryland	1.30	1.27	1.29	1.34	1.14
Massachusetts	3.00	2.73	2.89	2.81	2.53
Michigan	2.47	2.58	2.57	2.27	2.20
Minnesota	2.43	2.27	2.49	2.35	1.91
Mississippi	0.82	0.85	0.85	0.84	0.77
Missouri	0.75	0.72	0.74	0.73	0.63
Montana	1.16	1.17	1.27	1.42	1.41
Nebraska	0.75	0.76	0.73	0.78	0.70
Nevada	0.00	0.00	0.00	0.00	0.00
New Hampshire	2.23	2.42	2.58	2.26	1.83
New Jersey	1.78	1.91	1.85	1.94	2.02
New Mexico	0.88	0.99	0.93	0.93	0.92
New York	1.80	1.72	1.41	1.31	1.61
North Carolina	1.28	1.31	1.28	1.34	1.12
North Dakota	0.92	0.76	0.91	1.02	0.97
Ohio	1.08	1.42	1.38	1.38	1.22
Oklahoma	0.67	0.75	0.68	0.53	0.59
Oregon	1.42	1.71	2.01	1.98	1.62
Pennsylvania	2.12	2.27	2.21	2.06	1.81
Rhode Island	2.14	2.09	2.43	2.14	1.87
South Carolina	1.72	1.76	1.75	1.75	1.57
South Dakota	0.00	0.00	0.00	0.00	0.00
Tennessee	1.48	1.47	1.44	1.44	1.30
Texas	0.00	0.00	0.00	0.00	0.00
Utah	0.91	0.94	0.93	1.04	0.95
Vermont	1.49	1.46	1.67	1.43	1.31
Virginia	0.89	0.82	0.85	0.75	0.64
Washington*	3.27	3.36	3.47	3.41	3.43
West Virginia	0.45	0.39	0.42	0.50	0.46
Wisconsin	1.90	1.94	1.97	1.75	1.33
Mean	1.34	1.39	1.42	1.39	1.26
Standard Deviation	.735	.720	.759	.694	.650

* Washington has a gross receipts tax which is similar to an income tax

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The Effects of the U.S. Income Tax Regulations' Transfer Pricing Rules on Allocative Efficiency

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ABSTRACT: The two most commonly used transfer pricing rules for tax purposes pursuant to Reg. Sec. 1.482 are the "resale price" method and the "cost plus" method. This paper analyzes the effects of each of these methods on the resource allocation decisions of multinational firms when the tax rate abroad is lower than in the U.S. We show that, relative to the resource allocation that would exist in the absence of taxation: (1) the resale price method can cause either an increase or decrease in imports, an overuse of domestic resources, and overproduction of the "most similar product"; and (2) the cost plus method causes a decrease in imports, a decrease in the use of domestic resources, and overproduction of the most similar product. These effects are reversed when the tax rate abroad is higher than in the U.S. In addition, we deal with the case where the MNE faces different transfer pricing regulations in the U.S. and the foreign country.

SINCE the publication of two seminal articles by Hirshleifer [1956, 1957], accounting and economics researchers have devoted considerable effort to analyses of transfer pricing. Most of this research has examined the incentive effects of transfer pricing. A question that has received less attention is how multinational enterprises (MNE's) react to transfer prices mandated by taxing authorities in the countries where they operate. The importance of this question has been recognized in the accounting literature. Choi and Mueller [1984, p. 432] state:

> Of all the adaptive mechanisms employed by the multinational company, perhaps none have proved as flexible nor as troublesome as the technique of pricing resource, service and technology transfers between affiliates of the multinational enterprise. The dimensions . . . become readily apparent when we recognize that transfer pricing (a) is conducted on a relatively larger scale internationally than it is domestically; (b) is affected by a larger number of variables . . . ; (e) affects social, economic and political relationships in entire countries.

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TABLE 1

CORPORATE INCOME TAX RATES (STATUTORY) IN REPRESENTATIVE FOREIGN COUNTRIES

Country	*Tax Rate*
Argentina	53%
Brazil	50%
Ecuador	35%
Hong Kong	18.5%
Indonesia	35%
Korea	33%
Philippines	35%
Taiwan	25%

The transfer pricing rules for U.S. tax purposes are contained in the Income Tax Regulations under Section 482 of the Internal Revenue Code. In this study we examine the effect of the "482 Regs." on optimal resource allocation decisions of MNE's. To focus on the effect of taxation on the resource allocation decisions of MNE's, we model centralized MNE's that do not need a transfer pricing mechanism for incentive purposes. We show that when domestic tax rates are different from foreign tax rates, the two most commonly used transfer pricing rules under the 482 Regs. cause resource allocation distortions or inefficiencies; that is, they cause the MNE to optimally allocate resources differently than it would in the absence of taxation. In addition, we present an alternative transfer price scheme that does not distort resource allocation.

Our analysis is based on a scenario in which a U.S.-based MNE purchases an intermediate product from a foreign subsidiary and resells it in the U.S. after incurring additional costs such as assembly, packaging, distribution, or marketing costs. We assume that tax rates in the foreign country are lower than U.S. tax rates (with the opposite assumption, all results would be reversed). At present, the maximum U.S. corporate tax rate is 34 percent. Tax rates for some of the foreign countries in which a U.S. MNE might choose to place a subsidiary are shown in Table 1.

The remainder of the paper is presented as follows. In Section I we review the accounting and economics literature on the transfer pricing-tax issues of MNE's. Section II presents a brief discussion of the relevant 482 Regs. In Section III we analyze the distortions caused by the Section 482 transfer pricing rules using an analytical model. Section IV presents the allocatively efficient transfer pricing scheme. Section V discusses the effects of other related factors that are not incorporated directly into the model. Conclusions and a brief summary are presented in Section VI.

I. PREVIOUS RESEARCH

There has been little accounting research concerning transfer pricing-tax issues for MNE's. Merville and Petty [1978] assumed production quantity as predetermined and, using a goal programming approach, found the optimal set of transfer prices such that the firm's goal of having a desired level of profits in each of several countries could be satisfied. Elam and Henaidy [1981] use linear programming to: (1) find the optimal divisional production quantities in the absence of taxation; and (2) using these production quantities, find the set of transfer prices that would minimize the firm's worldwide taxes. Neither study examines the effect of taxes and transfer prices on the *production decisions* of MNE's. Furthermore, both studies assume, unrealistically, that firms may choose their own transfer prices for tax purposes and, therefore, neither considers the 482 Regs. as constraints.

In contrast, there have been a number of studies in the economics literature that model the economic behavior of MNE's when transfer prices are constrained by tax regulations. Horst [1971] and Capithorne [1971] showed that if an MNE operates in more than one country with different tax rates, the worldwide profit-maximizing transfer price generally differs from the worldwide profit-maximizing transfer price in the absence of such tax differential. Under the Horst [1971] and Capithorne [1971] assumption of exogenous transfer prices, the profit-maximizing transfer price in the presence of taxation is fixed at either the upper or lower bound allowed by the taxing authorities to shift income to the country with the lower tax rates. The price does not vary with output or sales levels.

Recently, however, two studies [Eden, 1983, and Samuelson, 1982] have recognized that when taxing authorities promulgate transfer pricing rules, transfer prices become endogenous variables that may change with the level of production. Eden [1983] focused on a change in Canadian transfer pricing rules and showed that the effect could be somewhat offset by a change in production. Samuelson [1982] dealt with one of the transfer pricing rules under the 482 Regs., namely the "comparable uncontrolled price" or market value method. This research showed that when an imperfectly competitive market exists for the intermediate product, a firm can manipulate the intermediate product's transfer price through its production decisions. However, Samuelson also assumed that the firm has the flexibility to use marginal cost transfer pricing even when there is a market. This is not allowed by the regulations.

Benvignati [1985] presents evidence showing that only about 24 percent of U.S. MNE's use the comparable uncontrolled price method. The rest use one of the two non-market methods permitted by the 482 Regs., namely, the resale price method and the cost plus method. Our study analyzes these two non-market transfer pricing methods and their effect on resource allocation decisions of MNE's. Like Samuelson, we treat transfer prices as endogenous variables. Before addressing this problem, however, we briefly review the relevant 482 transfer pricing rules (see, also, Burns [1980]).

II. SECTION 1.482 TRANSFER PRICING RULES

Reg. Sec. 1.482-2(e) sets forth the rules that govern transfer prices for inventories for tax purposes. The regulations do not use the term "transfer price," but instead use the term "arm's length price of a controlled sale." The regulations use conventional definitions of "arm's length" and point out that "an arm's length price" normally includes a profit to the seller. "Controlled sale" is the regulations' term for internal sales, or sales within the firm.

Subparagraphs (2), (3), and (4) of Reg. Sec. 1.482-2(e) describe three methods for determining the appropriate transfer price. These methods are the comparable uncontrolled price method, the resale price method, and the cost plus method.

Under the comparable uncontrolled price method, the transfer price is equal to the price paid in comparable uncontrolled sales adjusted for differences in product or conditions of sale that have a "definite and reasonable ascertainable effect on price." An example of such a difference in product or conditions of sale given by the regulations is a minor modification of the product made by the buying (reselling) division to meet safety specifications. In short, the comparable uncontrolled price is the market price of the intermediate product.

The other two methods are used when a market for the intermediate product does not exist. Under the resale price method, the applicable transfer price is the selling price of the final product minus an "appropriate markup" on the sale. The appropriate markup is the final product's selling price multiplied by the gross profit percentage (gross profit/sales) earned by the buying (reselling) division on similar items[1] that are both bought and sold by the buying division on an uncontrolled basis. The resale price method must be used if the buying (reselling) division has a most similar product and if "substantial transformation" of the intermediate product does not take place in the buying division. Examples of costs not considered "substantial transformation" are packaging, distribution, or marketing costs.

While the resale price method is based on the final product's selling price, the cost plus method is based on the cost of the intermediate product. Under this method, the transfer price is the intermediate product's cost plus an "appropriate markup" on the cost. The appropriate markup is the intermediate product's cost multiplied by the gross profit percentage (gross profit/cost of sales) earned by the selling division on similar items sold on an uncontrolled basis. The cost plus method must be used if an intermediate product exists in the selling division but not in the buying division or if an intermediate product exists in both divisions but substantial transformation takes place in the buying division.

III. THE MODEL

Assume that an MNE has two divisions: a manufacturing (*m*) division located in a foreign country and a distribution (*d*) division located in the United States. Formally *m* division is a wholly-owned subsidiary of *d* division incorporated under the laws of the country in which it is located. Technically, *m* division is a controlled foreign corporation (CFC) pursuant to Internal Revenue Code (IRC) Section 957(a). We further assume that *m*'s manufacturing activities take place exclusively in its country of incorporation and residence. Therefore, its income from manufacturing is not subject to immediate U.S. taxation as "foreign base company sales income" (Reg. Sec. 1.954-3(a)(2)). Accordingly, no U.S. taxes are payable on *m*'s income until it is paid to *d* as dividends. We assume that *m* currently pays no dividends to *d*.[2] *m* division manufactures an intermediate product, q_m, using one factor of production, x_m, whose unit cost is p_m. $q_m = F(x_m)$, where $F(\cdot)$ is *m*'s production function. We assume decreasing marginal productivity: $dF/dx_m > 0$ and $d^2F/dx_m^2 < 0$. *d* purchases q_m at transfer price r, and then transforms q_m into the final product, q_d, using an additional factor of production, x_d, whose unit cost is p_d. $q_d=G(q_m,x_d)$. *d* division also faces declining marginal productivity of both factors of production:

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[1] One similarity characteristic is that the geographic market in which the final product is sold is the same as the geographic market in which the "similar product" is bought and sold.

[2] Section V of this paper discusses how our results change if *m*'s income is subject to immediate U.S. taxation.

$$\partial G/\partial q_m,\ \partial G/\partial x_d>0;$$

$$\partial^2G/\partial q_m^2,\ \partial^2G/\partial x_d^2<0,\ \frac{\partial^2G}{\partial q_m \partial x_d}<0.$$

We assume that q_m and x_d are normal factors of production, i.e., an increase (decrease) in x_d implies and is implied by an increase (decrease) in q_m. q_d is sold in an imperfectly competitive market and yields a revenue $R_d(q_d)$. In addition, we require that $F(\cdot)$ and $G(\cdot,\cdot)$ be independent functions.

In the absence of taxation, the firm's problem is:

$$\underset{x_m,x_d,q_d,q_m}{\text{Maximize}} \quad (R_d(q_d)-p_dx_d-r_tq_m)+(r_tq_m-p_mx_m)$$

subject to:

$$q_d=G(q_m,x_d),\text{ and}$$
$$q_m=F(x_m) \tag{1}$$

where r_t represents the transfer price for the intermediate product.

The solution to this problem [Kanodia, 1979], is:

$$R_d' \frac{\partial G}{\partial q_m} \frac{dF}{dx_m}=p_m \tag{2}$$

and

$$R_d' \frac{\partial G}{\partial x_d}=p_d \tag{3}$$

Equation (2) is the well-known Hirshleifer result that, at optimality, the net marginal revenue (marginal revenue − marginal distribution cost) must equal marginal manufacturing cost. Since these equations give the firm's optimal resource allocation without taxes, they may be used as benchmarks against which the firm's resource allocation in the presence of taxes is measured.

Under differential taxation, and in the absence of any transfer pricing regulation, the firm's problem is:

$$\underset{x_m,x_d,q_m,q_d,r_t}{\text{Maximize}} \quad \tau_d(R_d(q_d)-p_dx_d-r_tq_m)+\tau_m(r_tq_m-p_mx_m)$$

subject to:

$$q_d=G(q_m,x_d),\text{ and}$$
$$q_m=F(x_m) \tag{4}$$

where

$\tau_m=1-$effective tax rate of *m* division[3]

and

$\tau_d=1-$effective tax rate of *d* division.

Let τ_d be less than τ_m. In this case, the transfer price r_t will be set at such a level that all the profits are transferred to the *m* division, i.e.,

$$r_t=\frac{R_d(q_d)-p_dx_d}{q_m}. \tag{5}$$

The after-tax profit of the firm, then, is:

$$\tau_m(R_d(q_d)-p_dx_d-p_mx_m). \tag{6}$$

Equation (6) is equation (1) multiplied by τ_m. The solution is also given by equations (2) and (3). This result also holds for $\tau_m \leq \tau_d$. Therefore, differential taxation, by itself, does not introduce resource allocation distortions.

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[3] Effective tax rates can differ from statutory tax rates for a number of reasons. First, *m* division may be new and therefore have start-up losses which can be carried forward in the foreign country. If these losses are large enough to offset current year's income in the foreign country, the tax rate in the foreign country is effectively zero. Second, *d* division may wish to repatriate the earnings of *m* division some time in the future. In this case, the effective tax rate for *m* division is a function of the effective tax rate in the foreign country and the present value of the U.S. tax payable upon repatriation. Other facts that may affect effective tax rates are foreign exchange rate changes or foreign tax credit carryovers.

We now analyze the joint affects of differential taxation and the 482 transfer pricing rules.

Resale Price Method

The resale price method requires the transfer price to be the final product's selling price minus a markup. The markup is the final product's selling price multiplied by the gross profit percentage (as a percentage of sales) earned by the buying or reselling division on similar items bought and sold by that division on an uncontrolled basis.

Suppose that *d* buys and sells product q_u on an uncontrolled basis. Let R_u be the total revenue received from the sale of q_u and let C_u be the total inventoriable costs associated with q_u. The resale price method states that:

$$r_t = \left[\frac{R_d(q_d)}{q_d} - \frac{R_d(q_d)}{q_d}\left(\frac{R_u - C_u}{R_u}\right)\right] \times \frac{q_d}{q_m} = \frac{R_d(q_d)}{q_m}\,\frac{C_u}{R_u}. \qquad (7)$$

The term in the square brackets in equation (7) comes directly from the regulations and q_d/q_m scales the transfer price in terms of q_m.[4] The production of q_u will be assumed to be subject to increasing marginal cost.[5]

The firm's problem is:

$$\underset{x_d, x_m, q_u}{\text{Maximize}} \quad \tau_d(R_u - C_u + R_d(q_d) - p_d x_d - r_t q_m) + \tau_m(r_t q_m - p_m x_m)$$

subject to:

$$q_d = G(q_m, x_d)$$
$$q_m = F(x_m)$$
$$r_t = \frac{R_d(q_d)}{q_m}\,\frac{C_u}{R_u}. \qquad (8)$$

τ_d is assumed to be less than τ_m. Since the firm is centralized, x_m, x_d, and q_u are all decision variables.

The solution to equation (8), found in the Appendix, Part A, is:

$$\left[\left(\frac{\tau_d}{\tau_m} - 1\right) K_u + 1\right] \times R_d' \frac{\partial G}{\partial q_m}\,\frac{dF}{dx_m} = p_m \qquad (9)$$

$$\left[\left(1 - \frac{\tau_m}{\tau_d}\right) K_u + \frac{\tau_m}{\tau_d}\right] \times R_d' \frac{\partial G}{\partial x_d} = p_d \qquad (10)$$

and

$$\tau_d(R_u' - C_u') - (\tau_m - \tau_d) R_d' [G(q_m, x_d)] \left(\frac{C_u R_u' - R_u C_u'}{R_u^2}\right) = 0, \qquad (11)$$

where $K_u = (R_u - C_u)/R_u$, R_u' is q_u's marginal revenue, and C_u' is q_u's marginal cost.

---

[4] The spirit of the resale price method at first glance appears to be that the firm should earn the same gross profit percentage on q_d as it earns on q_u. A careful reading of the regulations, however, reveals that the term $p_d x_d$ should not be subtracted in computing the gross profit percentage. The reason seems to be that the resale price method is usually (but not always) applicable when the input x_d is not substantial. In cases where x_d is substantial, unless the resale price method is deemed more appropriate for some other reasons, the cost plus method must be used.

[5] We require that the demand for q_d not influence the demand for q_u, i.e., that there be demand independence between q_d and q_u.

We can determine the effect of the resale price method by comparing equations (9), (10), and (11) with "benchmark" equations (2) and (3). First compare equation (9) with equation (2). If K_u (the gross profit percentage of the most similar product) is zero, then equations (2) and (9) are identical. As K_u increases from zero to some positive constant less than one, the quantity in square brackets in equation (9) falls since $(\tau_d/\tau_m)-1$ is negative. To compensate for this decrease, $(\partial G/\partial q_m)(dF/dx_m)$ must increase. This will occur if and only if x_m decreases.

Now compare equation (10) with equation (3). When K_u is zero, equation (10) is not identical with equation (3), but becomes

$$\frac{\tau_m}{\tau_d} R_d' \frac{\partial G}{\partial x_d}=p_d \tag{12}$$

Since $\tau_m/\tau_d>1$, the left side of equation (12) will be greater than the left side of equation (3) unless $\partial G/\partial x_d$ in equation (12) decreases. This will occur if x_d in equation (12) is at a higher level than in equation (3). The fact that x_d in equation (12) is greater than x_d in equation (3), when K_u is zero, also implies that the levels of q_m and x_m in equation (12) are greater than their levels in equation (2) when K_u is zero. This result follows because x_m and x_d are normal factors of production.

As K_u increases, the term in square brackets in equation (10) decreases, approaching one from above. To compensate for this decrease, x_d must also decrease.

When K_u gets very close to one, equation (9) approaches

$$\frac{\tau_d}{\tau_m} R_d' \frac{\partial G}{\partial q_m}\frac{dF}{dx_m}=p_m \tag{13}$$

and equation (10) approaches

$$R_d' \frac{\partial G}{\partial x_d}=p_d. \tag{14}$$

Since $\tau_d/\tau_m<1$, the left side of equation (13) is less than the left side of equation (2). To restore equality, $(\partial G/\partial q_m)(dF/dx_m)$ in equation (13) must increase. This will occur if x_m, and consequently q_m, in equation (13) decreases. Although equation (14) and equation (3) are identical, $\partial G/\partial x_d$ is evaluated at a lower value of G in equation (14) than in equation (3). Therefore, x_d also decreases. Thus, when K_u approaches one, x_d, x_m, and q_m are all smaller than in the no-tax case.

This analysis demonstrates that, when K_u is very small, imports are larger than in the no-tax world. As K_u increases, imports decrease. Finally, as K_u approaches its largest possible value, imports are smaller than in the no-tax world.

The above analysis showed that the MNE's resource allocation is a decreasing function of K_u. In addition, it can be demonstrated that, except in special cases, the use of the resale price method with any K_u cannot result in the same resource allocation as in a no-tax world. Dividing equation (2) by equation (3) gives

$$\frac{(\partial G/\partial q_m)(dF/dx_m)}{\partial G/\partial x_d}=\frac{p_m}{p_d} \tag{15}$$

or the familiar equilibrium condition that, in a no-tax world, the marginal rate of technical substitution (MRTS) must equal the ratio of the factor prices. Dividing equation (9) by equation (10) gives, after rearranging terms,

$$\frac{(\partial G/\partial q_m)(dF/dx_m)}{\partial G/\partial x_d}=\frac{\tau_m}{\tau_d}\frac{p_m}{p_d}. \tag{16}$$

The right side of equation (16) is greater than the right side of equation (15) since $\tau_m/\tau_d>1$. Therefore, the left side of equation (16) must also be greater than the left side of equation (15). This will occur if more x_d is used per unit of x_m in equation (16) than in equation (15). Therefore, under differential taxation, the use of the resale price method distorts the MNE's resource allocation decision in favor of x_d. Note also that equation (16) is independent of K_u. This independence implies that except in the special case where G is a fixed-proportions production function, the optimal allocation of resources under the resale method cannot be the same as in a no-tax world.

So far we have shown that optimal sales of the final product and use of the factors of production are inversely related to the gross profit percentage of the most similar product. We will now examine equation (11) and the gross profit percentage of the most similar product, which leads to the overall maximum profit for the MNE.

In the absence of taxation, the profit-maximizing condition for q_u is to set R_u' equal to C_u'. Substituting R_u' for C_u' into the left side of equation (11) makes it:

$$\tau_d(R_u' - R_u') - (\tau_m - \tau_d)R_d' G(q_m, x_d) \left(\frac{C_u R_u' - R_u R_u'}{R_u^2}\right)$$

or

$$-(\tau_m - \tau_d)R_d' G(q_m, x_d) \left(\frac{R_u'}{R_u}\right)\left(\frac{C_u}{R_u} - 1\right). \tag{17}$$

Equation (17) is positive since $\tau_m > \tau_d$; R_d', G, and R_u'/R_u are all positive and $(C_u/R_u) - 1$ is negative. $(C_u/R_u) - 1$ is negative since at the level of q_u at which $R_u' = C_u'$, $R_u > C_u$. Accordingly, at the level of q_u at which q_u's own profits are maximized, the left side of equation (11) is positive, which implies that the MNE's overall profits are not being maximized. Equation (11) can be driven to zero, the overall profit-maximizing condition, by causing C_u' to rise. This will occur at a point where $C_u' \geq R_u'$ or where the MNE produces more q_u than is optimal in the absence of taxation. Thus, the resale price method introduces a distortion in q_u as well as in q_d.

The resale price method causes the MNE to "overproduce" the most similar products in order to reduce its gross profit percentage. This reduction causes an increase in the transfer price. Thus, an increase in the transfer price increases production, sales, and profits from the final product, all else held constant.

The distortion in q_u is shown graphically in Figure 1. Curve *OAB* represents the profit from the sale of q_u as a function of the amount of q_u sold. Curve *OCD* represents the optimal profit from the sale of q_d given a certain sales level of q_u. (Recall that an increase in q_u reduces q_u's gross profit percentage which, in turn, increases the transfer price, which, in turn, increases sales of q_d.) Curve *OEF* is the vertical sum of *OAB* and *OCD* and represents total firm profit as a function of q_u. In a no-tax world, the firm would produce $\hat{q}_u$ and would make its production decision for q_d independent of the level of q_u chosen. The resale price method, by linking q_u with q_d, causes $\hat{q}_u$ to no longer be optimal, since $\hat{q}_u$ gives a firm-wide profit of $\hat{\pi}$. The firm can increase its profits to an overall optimal level π^* by increasing its production to q_u^*.[6]

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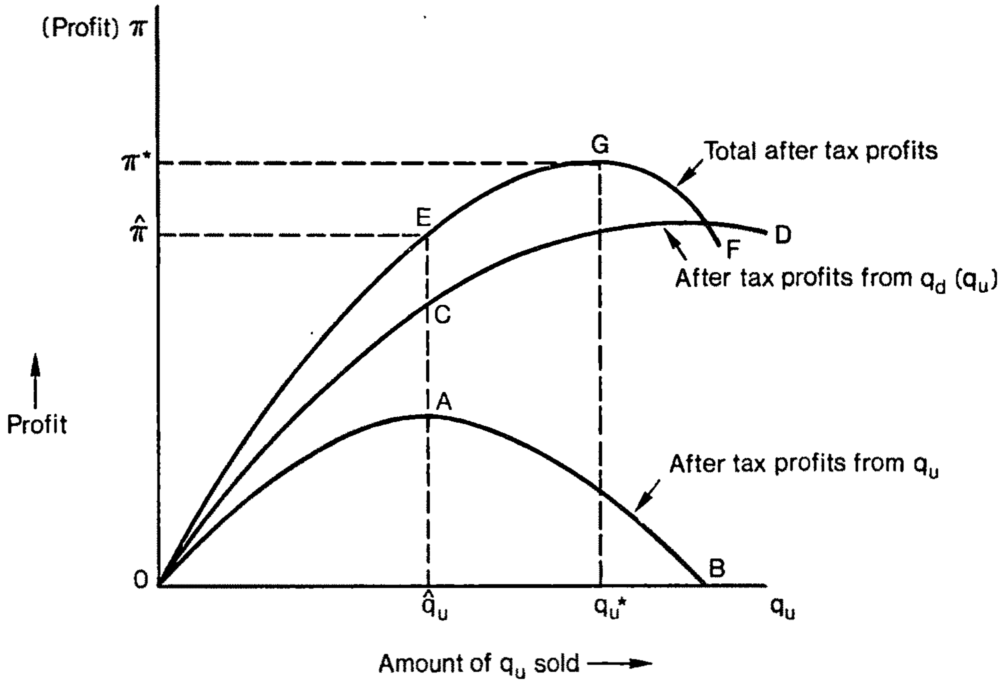
[6] By showing that the optimal solution includes overproduction of q_u, we don't mean to imply that the firm will refrain from using accounting techniques to shift income from *d* to *m*. For example, the firm may have a corporate headquarters that serves the entire firm. It is reasonable to expect the firm to allocate as much of headquarters cost to highly-taxed *d* division as is allowable. In addition, there may be some accounting tech-

FIGURE 1

OPTIMAL PROFIT AS A FUNCTION OF q_u USING THE RESALE PRICE METHOD



q_u: Quantity of the "most similar product" sold by the d division

$q_d(q_u)$: Quantity of the main product sold given q_u

$\hat{q}_u$: Quantity q_u at which the marginal revenue from q_u equals marginal cost from q_u

$\hat{\pi}$: Total after tax profit that would be realized by the firm if $q_u = \hat{q}_u$

q_u^*: Quantity q_u at which total after tax profit is maximized

π^*: Total after tax profits if $q_u = q_u^*$

Cost Plus Method

The cost plus method requires the transfer price to be the intermediate product cost plus an appropriate markup on cost. The appropriate markup is the intermediate product's cost multiplied by the gross profit percentage (as a percentage of *cost*) earned by the selling division on similar items sold on an uncontrolled basis.

Suppose that m manufactures and sells q_s on an uncontrolled basis. R_s is total revenue from the sale of q_s, and C_s is the total cost of manufacturing q_s.[7] The cost plus method states that:

$$r_t = \frac{p_m x_m}{q_m} + \frac{p_m x_m}{q_m}\left[\frac{R_s - C_s}{C_s}\right] = \frac{p_m x_m}{q_m}\,\frac{R_s}{C_s} \qquad (18)$$

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niques that can decrease q_u's gross profit percentage. Analytically, these techniques are in the nature of lump-sum transfers of income from d to m which have no effect on the optimal solution.

[7] To be as general as possible, we have assumed the market for q_s to be imperfectly competitive. Even if it has a perfectly competitive market, the increasing marginal cost allows the gross profit percentage to be changed by changing the level of sales of q_s.

where $p_m x_m / q_m$ is the cost of producing one unit of q_m.

The firm's problem is:

$$\underset{x_d, x_m, q_s}{\text{Maximize}} \quad \tau_d(R_d(q_d) - p_d x_d - r_t q_m) + \tau_m(r_t q_m - p_m x_m + R_s - C_s)$$

subject to:

$$q_d = G(q_m, x_d)$$

$$q_m = F(x_m)$$

$$r_t = \frac{p_m x_m}{q_m} \frac{R_s}{C_s}. \tag{19}$$

The solution to equation (19), found in the Appendix, Part B, is:

$$\left[\frac{1}{1 - \left(\frac{\tau_m}{\tau_d} - 1\right) K_s}\right] \times$$

$$R_d' \frac{\partial G}{\partial q_m} \frac{dF}{dx_m} = p_m \tag{20}$$

$$R_d' \frac{\partial G}{\partial x_d} = p_d \tag{21}$$

and

$$(\tau_m - \tau_d) p_m x_m \left(\frac{C_s R_s' - R_s C_s'}{C_s^2}\right)$$

$$+ \tau_m (R_s' - C_s') = 0 \tag{22}$$

where $K_s = (R_s - C_s)/C_s$, R_s' is q_s's marginal revenue and C_s' is q_s's marginal cost.

A comparison of equation (20) with benchmark equation (2) and equation (21) with benchmark equation (3) shows the effect of the cost plus method on resource allocation. If K_s in equation (20) is zero, then equation (20) reduces to equation (2) and the cost plus method has no effect on resource allocation. A zero value for K_s is essentially meaningless, however, since a zero value for K_s means that the firm earns no profit from the sale of q_s. As K_s increases from zero, the term in square brackets on the left side of equation (20) becomes larger than one. To restore equality to equation (20), $(\partial G/\partial q_m)(dF/dx_m)$ must decrease. This decrease will occur if x_m increases. The increase in x_m, in turn, causes an increase in x_d for, although equation (21) and equation (3) are identical, equation (21) is evaluated at a higher level of G than in equation (3).

To determine the effect of the cost plus method on the relative usage of x_m and x_d requires us to compare MRTS under the cost plus method with that in the absence of taxes. MRTS under the cost plus method, determined by dividing equation (20) by equation (21), is

$$\frac{(\partial G/\partial q_m)(dF/dx_m)}{\partial G/\partial x_d}$$

$$= \left[1 - \left(\frac{\tau_m}{\tau_d} - 1\right) K_s\right] \frac{p_m}{p_d}. \tag{23}$$

The right side of equation (23) is smaller than the right side of equation (15), the optimal MRTS in the no-tax world. Accordingly, the left side of equation (23) must be smaller than the left side of equation (15). This will occur if there is relatively less x_d per unit of x_m in equation (23) than in equation (15). In addition, this relative decrease will become larger as K_s increases.

The cost plus method, then, causes a number of distortions. First, it causes more q_m to be imported than would occur in a no-tax world, since x_m is increased. Secondly, although use of x_d is increased absolutely, it decreases *relative* to x_m. Intuitively, an increase in K_s causes an increase in the transfer price of r_t, which shifts income from d

division to m division. The shift in income indirectly causes a decrease in the relative cost of producing q_m. As a result, more q_m will be produced. Since x_d is relatively more expensive, relatively less x_d will be used.

To determine the level of q_s for the firm, we use equation (22). In the absence of taxation, the profit-maximizing condition for q_s is to set $R_s' = C_s'$. Substituting C_s' for R_s' in the left side of equation (22) gives

$$\begin{aligned}&(\tau_m-\tau_d)p_m x_m\left(\frac{C_s C_s' - R_s C_s'}{C_s^2}\right)\\ &+\tau_m(C_s'-C_s')\\ &=(\tau_m-\tau_d)p_m x_m\frac{C_s'}{C_s}\left(1-\frac{R_s}{C_s}\right). \quad (24)\end{aligned}$$

Equation (24) is negative since $\tau_m > \tau_d$; p_m, x_m, C_s', C_s, and R_s are all positive, and $1-(R_s/C_s)$ is negative since, at the level of q_s at which $R_s' = C_s'$, $R_s > C_s$. Since equation (24) is negative, the firm can increase profits by decreasing q_s. Decreasing q_s causes an increase in $(R_s - C_s)/C_s$ which, in turn, causes an increase in the transfer price. An increase in the transfer price causes an increase in q_d, x_m, and x_d.

The distortion in q_s is shown graphically in Figure 2. Curve *OAB* represents the firm's total profit from the sale of q_s. Curve *CDE* represents the optimal profit from the sale of q_d given a certain sales level of q_s. (Recall that an increase in q_s reduces q_s's gross profit percentage, which, in turn, reduces the transfer price. The reduction in transfer price causes a reduction in the sales of q_d.) Curve *GHI* is the vertical sum of *OAB* and *CDE* and represents total firm profit as a function of q_s. In the absence of taxation, the production decisions for q_d and q_s are independent. Accordingly, in the absence of taxation the firm will produce $\hat{q}_s$. By linking q_s with q_d, the firm's overall profit is maximized at q_s^*. In other words, the firm can increase overall profits from $\hat{\pi}$ to π^* by reducing q_s from $\hat{q}_s$ to q_s^*.

Different Transfer Price Rules

Finally, we analyze the case where the IRS requires d division to use the resale price method and the foreign taxing authority requires m division to use the cost plus method.[8]

The firm's problem is

$$\underset{x_m,x_d,q_u,q_s}{\text{Maximize}}\quad \begin{aligned}&\tau_d(R_u - C_u + R(q_d) - p_d x_d)\\ &+t_d r_{td} q_m\\ &+\tau_m(R_s - C_s - p_m x_m)\\ &-t_m r_{tm} q_m\end{aligned}$$

subject to:

$$\begin{aligned}q_d &= G(q_m, x_d)\\ q_m &= F(x_m)\\ r_{td} &= \frac{R_d(q_d)}{q_m}\,\frac{C_u}{R_u}\\ r_{tm} &= \frac{p_m x_m}{q_m}\,\frac{R_s}{C_s} \qquad (25)\end{aligned}$$

where t_d and t_m are the effective tax rates for divisions d and m respectively, r_{td} is the "import" transfer price, and r_{tm} is the "export" transfer price.

The solution to the problem in (25) found in the Appendix, Part C, is

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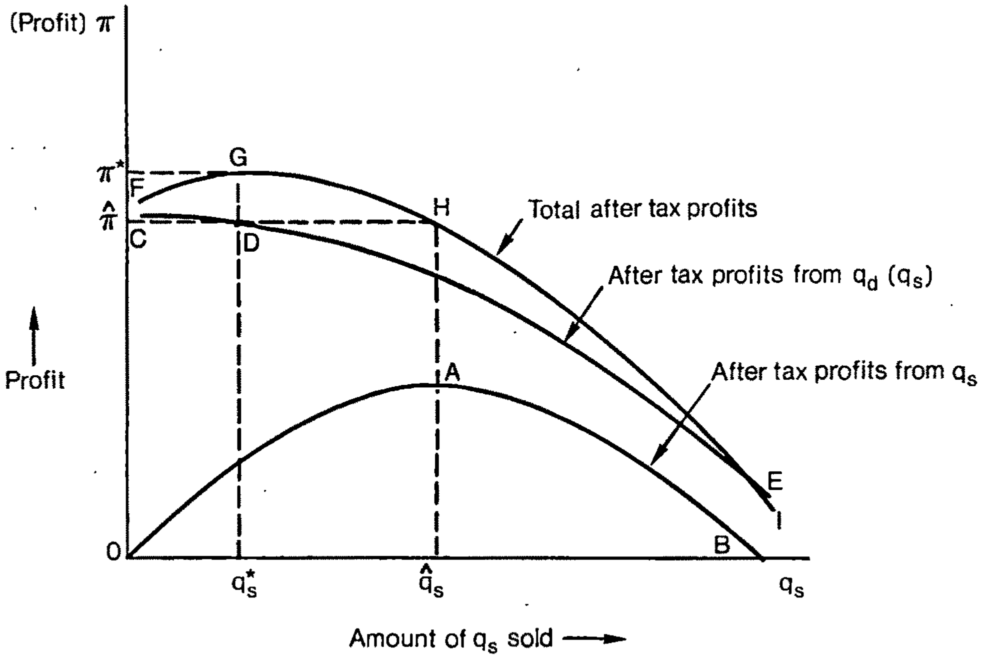
[8] We chose this scenario for the following reason. If there is no market for the intermediate product and resale price method is feasible, it has to be used for tax reporting to the U.S., since use of resale price method abroad and cost plus method in U.S. is in violation of the U.S. transfer price regulations.

FIGURE 2

OPTIMAL PROFIT AS A FUNCTION OF q_s USING THE COST PLUS METHOD



q_s: Quantity of the "most similar product" sold by *m* division
$q_d(q_s)$: Quantity of the main product which would be sold by *d* division given q_s
$\hat{q}_s$: Quantity of q_s at which the maximal revenue from q_s equals maximal cost from q_s
$\hat{\pi}$: Total after tax profits if $q_s=\hat{q}_s$
q_s^*: Quantity q_s at which the total after tax profit is maximized
π^*: Total after tax profits if $q_s=q_s^*$

$$R_d' \frac{\partial G}{\partial q_m} \frac{dF}{dx_m} \left[\frac{\tau_d+(1-\tau_d)(C_u/R_u)}{\tau_m+(1-\tau_m)(R_s/C_s)}\right] = p_m \qquad (26)$$

$$\frac{(\partial G/\partial q_m)/(dF/dx_m)}{\partial G/\partial x_d} = \frac{\tau_m+(1-\tau_m)(R_s/C_s)}{\tau_d}\,\frac{p_m}{p_d} \qquad (27)$$

$$R_u' - C_u' = -\frac{(1-\tau_d)}{\tau_d} R_d \frac{d}{dq_u}\left(\frac{C_u}{R_u}\right) \qquad (28)$$

$$R_s' - C_s' = \frac{1-\tau_m}{\tau_m} p_m x_m \frac{d}{dq_s}\left(\frac{R_s}{C_s}\right) \qquad (29)$$

The right-hand side of (28) is negative

and, therefore, more of q_u will be bought and sold by d division than in the no-tax world. The right-hand side of (29) is also negative and therefore, more of q_s will be manufactured and sold than in the no-tax world. The effect of these changes in q_u and q_s is an increase in the transfer price reported to the U.S. government and a decrease in the transfer price reported to the foreign government. This effect holds irrespective of the relative tax rates of the two countries. A comparison of (27) with (16) and (23) shows that the MRTS here is higher than in either of those two cases. This implies that relatively more x_d will be used per unit of x_m in this case than where resale price method or cost plus method is used symmetrically.

IV. ALLOCATIVELY EFFICIENT TRANSFER PRICE

We have shown that both the resale price method and the cost plus method of determining transfer prices for MNE's cause distortions in use of the factors of production and in sales of final product and the most similar product. A relevant question is, "Is it possible to design an allocatively efficient transfer pricing scheme?"

To be allocatively efficient, the transfer pricing scheme must result in an optimal solution for the firm which does not change the firm's resource allocation from the no-tax case. Given our model, this means that the transfer pricing scheme must result in the resource allocation shown in equations (2) and (3). According to the Appendix, Part D, this transfer price is

$$R_d' \frac{\partial G}{\partial q_m}$$

or, equivalently, $p_m/(dF/dx_m)$.

$$R_d' \frac{\partial G}{\partial q_m}$$

is the marginal revenue product from converting one unit of q_m into q_d. $p_m/(dF/dx_m)$ is the marginal cost of converting one unit of x_m into q_m. In equilibrium, these two amounts will be equal, and this equilibrium value represents the efficient transfer price.

Note that the efficient transfer price is independent of the tax rates on both divisions. Accordingly, the transfer pricing rule does not have to change when tax rates change. In addition, since the rule is independent of tax rates, the rule should apply in the case where tax rates for m and d divisions are both zero. In fact, the rule does apply, for it is identical with Hirshleifer's [1956] marginal cost transfer pricing rule, computed in the absence of taxation.

In addition, the marginal cost transfer pricing rule does not have "most similar products." Therefore, the firm is free to treat these as independent of the final product, q_d. Unlike q_d, which is taxed in two jurisdictions, most similar product q_u is taxed only at d division's tax rate and most similar product q_s is taxed only at m division's tax rate. The combination of (1) the independence of q_u or q_s from q_d and (2) the fact that q_u and q_s are taxed at only one tax rate is sufficient to show that, if all else is constant, the resource allocation for q_u or q_s is efficient.[9]

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[9] One might contemplate whether marginal cost transfer pricing is acceptable for tax purposes as an "other" method pursuant to Reg. Sec. 1.482-2(e). The reason that the regulations emphasize use of the resale price and cost plus methods seems to be that these methods approximate "arm's length" prices. Unfortunately, we have no information as to whether the IRS would also view marginal cost transfer pricing as being arm's length.

V. OTHER CONSIDERATIONS

To highlight the resource allocation distortions caused by the resale price and cost plus methods of transfer pricing, we ignored several other tax and economic factors that MNE's face. We will discuss a number of these factors here, and explain their impact on our results.

Tax Rates

The results of Section III hold only when foreign and domestic tax rates differ. When foreign and domestic tax rates are the same, there is no resource allocation distortion for either the final product or the most similar product under either of the transfer pricing methods.[10] Accordingly, any provision of the Internal Revenue Code which, in fact, causes the two tax rates to coincide will remove the distortion. When effective U.S. tax rates exceed foreign tax rates, such provisions are all those that require immediate U.S. taxation of foreign-source income.[11] Examples of such provisions are the immediate U.S. taxation of the income of a foreign branch (as opposed to a subsidiary) of a U.S. company, or the immediate U.S. taxation of the income of a controlled foreign corporation pursuant to Subpart F of the Internal Revenue Code.

The problem becomes more complex if the MNE has a number of foreign subsidiaries, some in countries with higher and some with lower effective tax rates than the U.S. IRC Section 904 requires that the foreign tax credit limitation be computed on an overall basis. If total foreign income taxes as a proportion of total foreign income exceeds effective U.S. tax rates, not all foreign taxes will be creditable against U.S. taxes when dividends are repatriated. In this situation, the MNE's objective is to minimize these excess foreign tax credits. This can be accomplished by shifting income from the U.S. to those subsidiaries in lower-taxed countries and shifting income to the U.S. from higher-taxed countries on a country-by-country basis. Accordingly, existence of several subsidiaries does not change our results.

Intangibles

One of the factors ignored in our model is intangibles. If a foreign subsidiary manufactures a product where the U.S. parent holds a patent on the product itself or on the production process, the U.S. parent is required to charge the subsidiary for use of the patent. According to Reg. Sec. 1.482-2(d)(2), the charge may take the form of a royalty based on the manufacturing division's output, sales, etc., or it may be a lump-sum payment.

A lump-sum payment would have no effect on our results in Section III. The U.S. parent would include some constant amount in its income and the subsidiary would include the same amount as a deduction. This constant would drop out when taking the relevant partial derivatives, thereby leaving our results unchanged.

If the charge is based on output, our results will change in magnitude, but not in direction. Suppose *m* division must pay *d* division a charge, *z*, per unit of q_m produced and sold. From the firm's perspective, this charge increases the worldwide after-tax cost of q_m by

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[10] Note that when $\tau_m = \tau_d$, equations (9) and (20) become equation (2), equations (10) and (21) become equation (3), equation (11) is zero when $R_u' = C_u'$, and equation (22) is zero when $R_s' = C_s'$.

[11] Although the foreign-source income is taxed both in the foreign country and in the U.S., the U.S. parent can claim a foreign tax credit for the foreign taxes paid. When U.S. tax rates exceed foreign tax rates, all foreign taxes are credited against U.S. taxes. Thus, effectively, the foreign-source income is taxed at the U.S. rate.

$(\tau_m - \tau_d)z$ per unit, assuming that τ_m does not change because of intangibles.[12] Accordingly, q_m becomes more expensive to produce and less q_m will be imported than when no per-unit charge is made.

Other Decision Alternatives

In the analysis above, we did not model other incentives and disincentives that the transfer pricing regulations might cause. Some of them are listed here.

The firm, if it has similar products in both divisions, may find one of the two methods more "profitable" than the other. In such a case, the firm will have an incentive to "choose" either the resale price method or the cost plus method. The regulations state that the cost plus method should be chosen only in cases where the resale price method is deemed clearly inappropriate because of substantial modification of the intermediate product, or infeasible because of not having a similar product in the distribution division. To some extent, the application of this criterion is subjective and the IRS may not be able to fully audit the compliance with this criterion.

The firm may also have an incentive to "create" a most similar product with low-volume operations which can be manipulated to adjust the transfer price of the final product. If more than one "most similar" product can be identified by the firm, the firm will identify one which, at the margin, provides the maximum benefit to the firm. Under the resale price method, the most similar product chosen will be one which, at the margin, has the lowest gross profit percentage. Under the cost plus method, the most similar product chosen will be one which, at the margin, has the highest gross profit percentage.

VI. CONCLUSIONS AND SUMMARY

In this study, we analyzed the effect of the two most widely used transfer pricing rules for tax purposes on the resource allocation decisions of an MNE. We found that both transfer pricing rules caused resource allocation distortions, although the distortions differ depending upon which transfer pricing rule is used. Our analysis was conducted assuming that tax rates abroad are lower than in the U.S.

Under the resale price method, it is not possible to determine whether the firm will sell more or less of the final product than it would in the absence of taxation. When the transfer price is high, sales of the final product will be higher than in the no-tax world and will decrease as the transfer price decreases to a point below sales of the final product in the no-tax world. In an effort to keep transfer prices high, the firm will overproduce the most similar product. We also showed that the firm will use relatively more domestic resources than it would in the absence of taxation, regardless of the amount of foreign resources used.

Under the cost plus method, the firm will increase its imports over their optimal level in the no-tax world. As in the case of the resale method, both the imports and sales of final product increase as the transfer prices increase. In an effort to keep transfer prices high, the firm will underproduce the most similar product and will use relatively less domestic resources than it would in the

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[12] In fact, τ_m may be affected by intangibles. Intangibles earned by a U.S. taxpayer are generally taxed differently in the foreign country than they are in the U.S. Often this results in a lower foreign tax rate being applied than would be applied to dividends or income from manufacturing. (We would like to thank an anonymous reviewer for pointing this out to us.)

TABLE 2

INPUT/OUTPUT LEVELS UNDER DIFFERENT TRANSFER PRICING REGIMES, COMPARED WITH THE NO-TAX WORLD

		q_{m1}	q_{m2}	r_t
Comparable Uncontrolled Price Method (From Samuelson)	$\tau_m > \tau_d$	Reduced	Increased	Higher*
	$\tau_m = \tau_d$	Same	Same	Same
	$\tau_m < \tau_d$	Not Considered	Not Considered	Not Considered

		x_m	x_d	q_d	r_t	q_u
Resale Price Method	$\tau_m > \tau_d$	Relatively less compared to x_d	Relatively less compared to x_m	Cannot tell	Higher*	Greater*
	$\tau_m = \tau_d$	Same	Same	Same	Same	Same
	$\tau_m < \tau_d$	Relatively more compared to x_d	Relatively more compared to x_m	Cannot tell	Lower*	Lower*

		x_m	x_d	q_d	r_t	q_s
Cost Plus Method	$\tau_m > \tau_d$	Relatively more	Relatively less	More*	Lower*	Lower*
	$\tau_m = \tau_d$	Same	Same	Same	Same	Same
	$\tau_m < \tau_d$	Relatively less	Relatively more	Less*	Higher*	Greater*

		x_m	x_d	q_d	r_{tm}	r_{td}	q_u	q_s
Resale Price (U.S.) and Cost Plus Method (Foreign)	$\tau_m > \tau_d$	Relatively** less	Relatively** more	Cannot tell	Lower*	Higher*	More*	More*
	$\tau_m = \tau_d$	Relatively** less	Relatively** more	Cannot tell	Lower*	Higher*	More*	More*
	$\tau_m < \tau_d$	Cannot tell	Cannot tell	Cannot tell	Lower*	Higher*	More*	More*

q_{m1}: Sale of the intermediate product in external market.
q_{m2}: Sale of the intermediate product to d division.
* These comparisons are with the no-tax world.
** These comparisons are with the cases where the same method (resale price or cost plus) is used by both divisions.

absence of taxation. Although we assumed that tax rates abroad are lower than in the U.S., had we made the opposite assumption, all of the distortions would have been reversed.

Under both methods, the distortions arise as a joint effect of the tax differential and the transfer pricing regulation. If either of these factors is absent, there would be no necessary distortion in the resource allocation pattern.

We also considered a case where the transfer pricing regulations of the U.S. and foreign country are different, and so two different transfer price regulations are used for tax reporting in the two countries. Specifically, we considered use of the resale price method in the U.S.

and the cost plus method abroad. This leads to overproduction of the most similar products in both divisions. The input/output level distortions in this case are not sensitive to the tax rate differential.

These results and the relevant results for the comparative uncontrolled method analyzed by Samuelson are presented in summary form in Table 2.

Though we have concentrated on distortions in resource allocation that reduce worldwide efficiency, the results can be interpreted in terms of the profit levels of the divisions and, consequently, the amount of taxes collected from the firm in the U.S. and the foreign country. In both the resale price and cost plus methods, the firm's overall pre-tax profit would be lower than in the unconstrained situation. In addition, the firm changes the resource allocation levels to shift taxes from the U.S. to the lower-taxed division abroad. These two effects, in conjunction, reduce taxes paid in the U.S. relative to the amount under the marginal cost transfer-pricing rule. No general assertions can be made, however, on the total after-tax profits of the firm or the amount of taxes paid to the foreign country.

APPENDIX

A. Solution to Equation (8)

After substituting the constraints into the objective function and rearranging terms we get π, the equation to be maximized, as

$$\begin{aligned}\pi = {}& \tau_d(R_u - C_u - p_d x_d) + (\tau_d - \tau_m)\left(\frac{R_u - C_u}{R_u}\right) R_d\{G(q_m, x_d)\} \\ & + \tau_m[R_d\{G(q_m, x_d)\} - p_m x_m] \end{aligned} \tag{A1}$$

Taking the partial derivatives of (A1) with respect to x_m, x_d, and q_u, respectively, and setting the results equal to zero gives

$$\frac{\partial \pi}{\partial x_m} = (\tau_d - \tau_m) R'_d \left(\frac{R_u - C_u}{R_u}\right) \frac{\partial G}{\partial q_m} \frac{dF}{dx_m} + \tau_m R'_d \frac{\partial G}{\partial q_m} \frac{dF}{dx_m} - \tau_m p_m = 0 \tag{A2}$$

$$\frac{\partial \pi}{\partial x_d} = (\tau_d - \tau_m) R'_d \left(\frac{R_u - C_u}{R_u}\right) \frac{\partial G}{\partial x_d} + \tau_m R'_d \frac{\partial G}{\partial x_d} - \tau_d p_d = 0 \tag{A3}$$

and

$$\frac{\partial \pi}{\partial q_u} = \tau_d(R'_u - C'_u) + (\tau_d - \tau_m) R'_d G(q_m, x_d) \left(\frac{C_u R'_u - R_u C'_u}{R_u^2}\right) = 0 \tag{A4}$$

Rearranging terms in (A2) through (A4) gives

$$\left[\left(\frac{\tau_d}{\tau_m}-1\right)\left(\frac{R_u-C_u}{R_u}\right)+1\right]R_d'\,\frac{\partial G}{\partial q_m}\,\frac{dF}{dx_m}=p_m \tag{A5}$$

$$\left[\left(1-\frac{\tau_m}{\tau_d}\right)\left(\frac{R_u-C_u}{R_u}\right)+\frac{\tau_m}{\tau_d}\right]R_d'\,\frac{\partial G}{\partial x_d}=p_d \tag{A6}$$

and

$$\tau_d(R_u'-C_u')-(\tau_m-\tau_d)R_d'G(q_m,x_d)\left(\frac{C_uR_u'-R_uC_u'}{R_u^2}\right)=0 \tag{A7}$$

B. Solution to Equation (*19*)

Substituting the constraints into the objective function of equation (16) gives

$$\pi=\tau_d(R_d\{G(q_m,x_d)\}-p_dx_d)+p_mx_m\left((\tau_m-\tau_d)\left(\frac{R_s-C_s}{C_s}\right)-\tau_d\right)$$
$$+\tau_m(R_s-C_s). \tag{B1}$$

Taking the partial derivatives of π with respect to x_m, x_d, and q_s, respectively, and setting the results equal to zero gives

$$\frac{\partial\pi}{\partial x_m}=\tau_dR_d'\,\frac{\partial G}{\partial q_m}\,\frac{dF}{dx_m}+p_m\left((\tau_m-\tau_d)\left(\frac{R_s-C_s}{C_s}\right)-\tau_d\right)=0, \tag{B2}$$

$$\frac{\partial\pi}{\partial x_d}=\tau_d\left(R_d'\,\frac{\partial G}{\partial x_d}-p_d\right)=0 \tag{B3}$$

and

$$\frac{\partial\pi}{\partial q_s}=(\tau_m-\tau_d)p_mx_m\left(\frac{C_sR_s'-R_sC_s'}{C_s^2}\right)+\tau_m(R_s'-C_s')=0. \tag{B4}$$

Rearranging terms in (B2) and (B3) gives equations (20) and (21). (B4) is equation (22).

C. Solution to Equation (*25*)

Substituting the constraints into the objective function of equation (25) gives

$$\pi=\tau_d(R_d\{G(q_m,x_d)\}-p_dx_d+R_u-C_u)+\tau_d\left(\frac{C_u}{R_u}\right)R_d\{G(q_m,x_d)\}$$
$$+\tau_m(R_s-C_s-p_mx_m)-t_mp_mx_m\left(\frac{R_s}{C_s}\right) \tag{C1}$$

Setting the partial derivatives of π with respect to x_d, x_m, q_m, and q_s equal to zero gives

$$\frac{\partial \pi}{\partial x_d} = \tau_d \left(R_d' \bullet \frac{\partial G}{\partial x_d} - p_d \right) + t_d R_d' \bullet \frac{\partial G}{\partial x_d} \bullet \frac{C_u}{R_u} = 0 \tag{C2}$$

$$\begin{aligned} \frac{\partial \pi}{\partial x_m} = \tau_d \left(R_d' \bullet \frac{\partial G}{\partial q_m} \bullet \frac{dF}{dx_m} \right) &+ t_d R_d' \frac{\partial G}{\partial q_m} \bullet \frac{dF}{dx_m} \frac{C_u}{R_u} \\ &- \tau_m p_m - t_m p_m \left(\frac{R_s}{C_s} \right) = 0 \end{aligned} \tag{C3}$$

$$\frac{\partial \pi}{\partial q_u} = \tau_d (R_u' - C_u') + t_d \frac{d}{dq_u} \left(\frac{C_u}{R_u} \right) R_d(G(q_m, x_d)) = 0 \tag{C4}$$

$$\frac{\partial \pi}{\partial q_s} = \tau_m (R_s' - C_s') - t_m p_m x_m \frac{d}{dq_s} (R_s/C_s) = 0 \tag{C5}$$

Rearranging the terms and substituting $t_d = (1 - \tau_d)$ and $t_m = (1 - \tau_m)$ in (C2) to (C5) gives equations (26) through (29).

D. Efficient Transfer Price

The firm's problem is

$$\underset{x_d, x_m}{\text{Maximize}} \quad \tau_d (R_d(q_d) - p_d x_d - r_t q_m) + \tau_m (r_t q_m - p_m x_m)$$

subject to:

$$\begin{aligned} q_d &= G(q_m, x_d), \text{ and} \\ q_m &= F(x_m) \end{aligned} \tag{D1}$$

This problem may be written as Lagrangian function L,

$$\begin{aligned} L = \tau_d (R_d(q_d) - p_d x_d - r_t q_m) &+ \tau_m (r_t q_m - p_m x_m) \\ + \lambda_d (q_d - G(q_m, x_d)) &+ \lambda_m (q_m - F(x_m)) \end{aligned} \tag{D2}$$

where λ_d and λ_m are Lagrangian multipliers. Taking relevant partial derivatives gives

$$\frac{\partial L}{\partial q_d} = \tau_d R_d' + \lambda_d = 0 \tag{D3}$$

$$\frac{\partial L}{\partial q_m} = -\tau_d r_t + \tau_m r_t - \lambda_d \frac{\partial G}{\partial q_m} + \lambda_m = 0 \tag{D4}$$

$$\frac{\partial L}{\partial x_d} = -\tau_d p_d - \lambda_d \frac{\partial G}{\partial x_d} = 0 \tag{D5}$$

$$\frac{\partial L}{\partial x_m} = -\tau_m p_m - \lambda_m \frac{dF}{dx_m} = 0 \tag{D6}$$

From (D3),

$$\lambda_d = -\tau_d R'_d. \tag{D7}$$

From (D4),

$$\lambda_m = -(\tau_m - \tau_d) r_t + \lambda_d \frac{\partial G}{\partial q_m}. \tag{D8}$$

Substituting (D7) into (D8) gives

$$\lambda_m = -(\tau_m - \tau_d) r_t - \tau_d R'_d \frac{\partial G}{\partial q_m}. \tag{D9}$$

Substituting (D9) into (D6) and rearranging terms gives

$$\left[(\tau_m - \tau_d) r_t + \tau_d R'_d \frac{\partial G}{\partial q_m}\right] \frac{dF}{dx_m} = \tau_m p_m. \tag{D10}$$

We want to find a value of r_t such that, when the firm solves (D10), the solution is equation (2).

Equation (2) may be written as

$$\tau_m R'_d \frac{\partial G}{\partial q_m} \frac{dF}{dx_m} = \tau_m p_m. \tag{D11}$$

Equating (D10) and (D11) gives

$$\left[(\tau_m - \tau_d) r_t + \tau_d R'_d \frac{\partial G}{\partial q_m}\right] \frac{dF}{dx_m} = \tau_m R'_d \frac{\partial G}{\partial q_m} \frac{dF}{dx_m}. \tag{D12}$$

Solving (D12) for r_t gives

$$r_t = R'_d \frac{\partial G}{\partial q_m}. \tag{D13}$$

Since equation (2) is

$$R'_d \frac{\partial G}{\partial q_m} \frac{dF}{dx_m} = p_m,$$

(D13) may also be written as

$$r_t = \frac{p_m}{dF/dx_m}. \tag{D14}$$

Substituting (D14) into (D5) and rearranging terms gives equation (3).

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The Incremental Information Content of Historical Cost and Current Cost Income Numbers: Time-Series Analyses for 1962–1980

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ABSTRACT: Previous investigations of the incremental information content of current cost income have focused on cross-sectional analyses, which assume that the relation between stock returns and specific price-level adjustments is the same for all firms. Beaver et al. [1982] suggest that such analyses may be misspecified and provide preliminary indications that the incremental information content of current cost income may be more evident in a time-series context. The study summarized here provides the first formal examination of the information content of current cost income and historical cost income within a time-series context. Some evidence of incremental information content in current cost income is found in the time-series analysis, even though none is evident in a cross-sectional analysis. However, incremental information content is (at best) evident only for a small subset of industries where the correlation between historical cost income and current cost income is low; for the majority of industries, the two income measures convey essentially the same information.

CURRENT cost income disclosures were required by Statement of Financial Accounting Standards No. 33 [FASB, 1979] only from 1980 to 1986. The preceding current cost disclosures required by SEC Accounting Series Release No. 190 [SEC, 1976] were available only from 1976 through 1979. As a result, insufficient data exist to permit a powerful time-series investigation of the information content of these disclosures. Researchers instead have focused on cross-sectional regressions of return metrics against accounting variables, including unexpected current cost income [Beaver and Landsman, 1983; Schaefer, 1984; Bublitz et al., 1985; and Bernard and Ruland, 1986]. Although the evidence is mixed, most studies detect no incremental information content

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in current cost income, relative to historical cost income. However, this conclusion may be the product of limitations of cross-sectional analyses that could potentially be overcome in a time-series analysis.

This paper summarizes an industry-by-industry time-series analysis of data encompassing 113 firms and 19 years. The research has been conducted in an attempt to overcome two limitations inherent in cross-sectional analyses. First, cross-sectional analyses used in previous studies assume that the relation between stock returns and alternative measures of unexpected income (e.g., historical cost and current cost income) is homogeneous for all firms and industries. When that relation is not homogeneous, estimated regression coefficients are a complex weighted average of the underlying parameters. As a result, it is possible to obtain an *estimated* coefficient on a regressor that is not reliably different from zero, even when the *true* coefficients of that regressor are non-zero for at least some subset of firms or industries.

There are reasons to suspect that the homogeneity assumption is incorrect and that the incremental information content of current cost income would vary by industry.[1] First, security price implications of changes in current costs could vary according to several industry-related economic characteristics, including customers' elasticity of demand, amount of competition in output markets, and the degree of friction in output prices. Second, the interpretation of a given deviation between current cost and historical cost income depends on the inventory and depreciation methods used to calculate the latter, and on rates of turnover of inventory and fixed assets. These factors also tend to vary by industry.

A second limitation of cross-sectional analyses arises because the unexpected components of historical and current cost income tend to be highly collinear, at least in cross-section. When the correlation between the two variables is extremely high, they communicate essentially the same information; any incremental information content is small and therefore difficult to detect. In the language of multiple regression, the coefficient estimates for the two variables tend to be imprecise and thus it is difficult to reject the hypothesis that the value of a particular parameter is equal to zero.

Since collinearity is a problem of limited diagnosticity in the data, no statistical procedure can overcome its effects [Christie et al., 1984]. However, if the original model is specified in time-series rather than in cross-section, collinearity may be less severe, at least in those industries where current cost adjustments are largest. If so, incremental information content may be evident for that subset of industries. In this study, although time-series regressions are estimated for the entire sample, the focus is on a subset of industries where the correlation between unexpected historical cost income and unexpected current cost income is relatively low.

Adoption of a time-series approach does not come without a price. Specification of the model in time-series assumes stationarity over time, which may be at least as problematic as assuming homogeneity across firms. Furthermore, the time-series approach necessitates estimation with sample sizes smaller than those used in prior cross-sectional tests. Nevertheless, as indicated below, prior research suggests that a time-series approach could yield results that differ in important respects from those of cross-sectional studies.

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[1] Tests of coefficient equality suggest that the homogeneity assumption is tenuous at best. Details of these tests appear in Bernard and Ruland [1986].

Two previous studies [Easman et al., 1979; Beaver et al., 1982] included informal examinations of the incremental information content of current cost income within a time-series context. Both studies were based on current cost data estimated by Easman et al., including six annual observations of estimated current cost income for approximately 80 firms. The studies concluded that for the average firm, current cost income from continuing operations was more highly correlated (over time) with stock returns than was historical cost income. When the same data were analyzed in cross-section by Beaver et al. [1982], there was little or no indication of incremental information content in the current cost data. Thus, the evidence suggests that differences between the time-series analysis and the cross-sectional analysis are important. However, given that only three degrees of freedom per firm were available in the Beaver et al. study, and given difficulties associated with cross-sectional dependence in their data, they suggested that "perhaps some reservations are in order regarding a time-series approach. Until these can be resolved, we hesitate to invest resources in conjectures about the reason for the findings" [p. 38]. The larger data set used in this study may partially overcome the research design problems that concerned Beaver et al., and may permit firmer conclusions on whether current cost data offer incremental information content in a time-series analysis.

The results of this study indicate that even though the time-series framework provides stronger evidence of incremental information content in the current cost data than does a cross-sectional framework, the evidence is still mixed. The strongest evidence is provided by an analysis that focuses on a subset of industries where the correlation between historical cost income and current cost income is relatively low. The null hypothesis that current cost income provides no incremental information content for any industry in the subset can be rejected at the .01 level; the same hypothesis for historical cost income cannot be rejected. However, this evidence must be interpreted cautiously. First, the analysis is based on a small subset of industries and the results appear largely attributable to a single industry in that subset. Second, the results of some supplementary analyses do not provide strong indications of incremental information content in current cost data.

I. DATA AND MEASUREMENT COSTS

The sample analyzed here consists of 113 U.S. corporations from 27 major industries, including firms from the following sectors: manufacturing, mining, petroleum refining, airlines, utilities, retailing, financial services, and consumer services. Sample selection was based primarily on data availability and was designed to obtain two to ten December or January fiscal-year-end firms in each industry.[2] For purposes of this study, the sample differs from the population of firms at large in three important ways. First, the sample firms tended to disclose more information about the dates and amounts of their capital expenditures than did other firms. This allowed for more precise estimation of current cost income than would have been possible otherwise. Second, the primary line of business of each of the firms remained constant throughout the period; thus, stability in the operating characteristics of these firms is likely to be higher than average. Third, since firms were included only if they existed throughout the 1961–1980 period, the typical "survivorship bias" is present.

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[2] The sample is a subset of the 136 firms studied by Bernard [1986], who describes the sample selection criteria in detail. To arrive at the subset of firms used here, 23 firms that did not have a December or January fiscal-year-end throughout the test period were eliminated.

Special caution should be exercised in interpreting results at the industry level. Since the number of sample firms per industry is small (on average, approximately four), the sample firms may not be representative of the industries from which they were selected. However, since the included firms are large (the full sample accounts for nearly one-fourth of the earnings generated by the U.S. corporate sector during the test period[3]), they may be of interest in their own right. For example, although the automobile industry is represented by only three firms, they are General Motors, Ford, and Chrysler. The two firms representing the electrical equipment industry are General Electric and Westinghouse.[4]

The analysis requires estimation of current cost income for the years 1961–1980.[5] The estimation procedures comply with those specified by Statement of Financial Accounting Standards No. 33 (SFAS No. 33) for calculation of current cost income from continuing operations. The estimates are intended to be as accurate as can reasonably be expected on the basis of publicly available information, and use much information not considered by others who have estimated current cost income.[6]

Table 1 compares our estimates with amounts reported in accordance with SFAS No. 33 in 1979 and 1980. The comparison (Panel A) indicates that estimated values of current cost statistics used in this study are reasonable approximations of those based on actual SFAS No. 33 disclosures. The correlation between estimated and reported current cost income from operations (scaled by sales) is .883. The correlation between the estimated and reported amount necessary to convert historical cost income to current cost income (scaled by the end of previous year market value of common equity) is .937. More important for this study, the unexpected component of estimated current cost income (first difference in income scaled by market value of common equity) behaves much like the unexpected component of reported current cost income. Correlation between those amounts is .986, and their distributional properties are nearly identical (Table 1, Panel B). Furthermore, cross-sectional simple and multiple regressions of raw returns against unexpected income measures yield similar results, whether estimated or reported current cost income measures are used (Table 1, Panel C).[7]

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[3] This statement is based on a comparison of taxes paid by the sample firms with total corporate income tax revenues per the National Income Accounts.

[4] A list of firms included in the sample is available from the authors.

[5] Data for the year 1961 are used only for purposes of generating expectations for 1962. Therefore, although current cost income is estimated for 20 years, the primary analysis is based on only 19 years of data (1962–1980).

[6] Procedures used to restate cost of sales are similar to those used by Falkenstein and Weil [1977]. The procedures accounted for within-firm variety in the contents of inventory and used specific price indexes chosen from over 1,000 wholesale price indexes furnished by the Bureau of Labor Statistics and the Citibank tapes. Depreciation was restated using the layering method discussed by Short [1985] and the fixed nonresident capital component of the GNP deflator. Rather than rely on estimates of the average age of plant to restate depreciation, as has been done in prior research, the layering method considers the actual past capital expenditures. Some supplementary tests also require an estimate of net monetary gain or loss. This estimate was generated by multiplying the average net monetary position for the year by the general inflation rate. The measure of net monetary position included all material monetary accounts, including those of unconsolidated but wholly-owned subsidiaries (see Bernard and Hayn [1986]).

[7] In the multiple regression (Panel C of Table 1), the coefficient on *UHC* (*UCC*) is somewhat higher (lower) when *UCC* is based on reported amounts rather than

TABLE 1

COMPARISON OF ESTIMATED CURRENT COST INCOME FROM CONTINUING OPERATIONS WITH AMOUNTS REPORTED IN ACCORDANCE WITH SFAS NO. 33[a]

A. Correlations Between Estimated and Reported Measures

Current cost income (scaled[b]): estimated vs. reported (160 observations for 1979–1980)	.883
Unexpected current cost income[c]: estimated vs. reported (72 observations for 1980)	.986
Difference between historical cost income and current cost income (scaled[d]): estimated vs. reported (160 observations for 1979–1980)	.937

B. Distributional Properties of Current Cost Statistics: Estimated vs. Reported (72 observations for 1980)

	Unexpected component of reported *current cost income*[c] *(1980)*	*Unexpected component of* estimated *current cost income*[c] *(1980)*
Mean	-.036	-.042
Standard deviation	.213	.222
Correlation with stock returns	.368	.376

C. Behavior in Cross-Sectional Regression: Estimated vs. Reported Amounts (72 observations from 1980)

Regressions of returns (R_t) against unexpected current cost income[c] (UCC_t) and unexpected historical cost income[c] (UHC_t)

UCC_t *based on* reported *amounts*	UCC_t *based on* estimated *amounts*
$R_t = .21 + .46(UCC_t)$ (3.31)	$R_t = .21 + .45(UCC_t)$ (3.40)
$R_t = .18 + 1.80(UHC_t) - 1.25(UCC_t)$ (1.75) (-1.27)	$R_t = .19 + .89(UHC_t) - .35(UCC_t)$ (1.06) (- .47)

[a] The analysis is based on a subset of the sample for which SFAS No. 33 data were available on the 1982 SFAS No. 33 tape.

[b] Scaled by sales.

[c] Unexpected income is defined as the first difference in income, scaled by the end of previous year market value of common shares.

[d] Scale factor is end of previous year market value of common shares.

An important implication of the evidence in Table 1 is that it would be possible to construct accurate estimates of current cost income for the firms in the sample from publicly available sources, even when current cost income itself is not reported. This suggests that stock prices could have reflected this information long before the existence of SFAS No. 33. Thus, while our study (and previous related research) does not pur-

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estimated amounts. However, such differences are not unexpected even if the estimated amounts are good proxies for reported amounts. Since *UHC* and *UCC* are highly correlated, the coefficient estimates are sensitive to even small changes in the regressors.

port to examine the information in SFAS No. 33 data beyond that available from other sources, it can provide evidence concerning whether the kind of information reflected in SFAS No. 33 disclosures appears to be used in the security price valuation process.

II. The Model

The model estimated in this study[8] is:

$$R_{it}=a_i+b_{1i}(UHC_{it})+b_{2i}(UCC_{it})+e_{it} \qquad \begin{matrix} i=1,2,\ldots N \\ t=1,2,\ldots T \end{matrix} \qquad (1)$$

where

R_{it} = mean stock return for firms in industry i for 12 months of calendar year t;

UHC_{it} = first difference in the mean historical cost income (before extraordinary items and discontinued operations) of industry i in year t, scaled by the market value of common stock at end of previous year [Christie, 1987];

UCC_{it} = first difference in mean current cost income from continuing operations of industry i in year t, scaled in same manner as UHC_{it};

a_i = industry-specific intercept;

b_{1i}, b_{2i} = industry-specific regression coefficients; and

e_{it} = disturbance term, assumed to be serially independent and normally distributed.

The data used to estimate equation (1) are aggregated within industries, with equal weight placed on each firm. By aggregating the data, information is forfeited and thus the power of the test may be reduced.[9] However, when the data are aggregated and attention is focused on subsets of industries, it becomes possible to use statistical tests that can explicitly account for cross-sectional dependence in the data. Beaver et al. [1982] cite their inability to deal with cross-sectional dependence as a limitation in interpreting their evidence, and Bernard [1987] shows that the potential for bias in standard errors due to cross-sectional dependence is serious in this context. It is hoped that information in current cost adjustments is largely industry-specific, rather than firm-specific (Freeman [1983] indicates that this is indeed the case). If so, grouping the data by industry will not result in a significant loss of power.

All data (including returns and the accounting variables) are expressed in terms of deviations from overall sample means (across the 27 industries) for the year. Such an approach is equivalent to including an intercept that varies by year (see Judge et al. [1980, section 8.3.1]), and can eliminate the effect of market-wide swings in returns.[10] When equation

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[8] Note that a single multiple regression is used, rather than the combination of two simple regressions used in previous studies (e.g., Beaver et al. [1980, 1982]; and Beaver and Landsman [1983]). As explained by Christie et al. [1984], the two approaches are mathematically equivalent (and thus, neither overcomes the problem of multicollinearity). The choice between the two is one of form rather than substance.

[9] To generate these estimates, the mean value across all firms within each industry was calculated for each variable in each year. Thus, each time-series regression involves only 19 observations, regardless of the number of firms in the industry. Since stock returns should be approximately uncorrelated over time, the resulting estimates of coefficient standard errors should not be biased due to dependence in the data.

[10] An alternative approach is to use market model residuals as the dependent variable. If this approach were adopted, consistency would require application of a market index model to the right-hand-side variables, as in Ball and Brown [1968]. We chose not to adopt this approach because our interest lies in *all* information conveyed by deviations of accounting variables from the sample average, regardless of whether the deviations are linearly related to a market index. Nevertheless, we did repeat the primary analyses using market model residuals as the dependent variable, and obtained results that are similar to those reported here

TABLE 2

TIME-SERIES REGRESSIONS OF RETURNS (R) AGAINST UNEXPECTED HISTORICAL COST INCOME (UHC) AND UNEXPECTED CURRENT COST INCOME (UCC)[a]

				Results of Multiple Regression				
	Simple Correlations			UHC		UCC		
Industry (*Number of firms*)	(R, UHC)	(R, UCC)	(UHC, UCC)	*Coef-ficient*	t-*value*	*Coef-ficient*	t-*value*	R-*squared*
Mining (3)	.73*	.75*	.98	−.34	−.12	3.34	1.06	.56**
Foods (3)	.19	.13	.88	2.08	.69	−.72	−.35	.04
Soda, Candy (5)	−.10	.12	.40	−1.69	−.71	.77	.76	.04
Tobacco (2)	.00	.04	.89	−.39	−.26	.50	.30	.01
Textiles, Apparel (4)	.52*	.55*	.97	−.12	−.13	.53	.77	.30**
Paper & Related (2)	.53*	.48*	.97	9.39	1.92*	−5.11	−1.31	.35**
Chemicals & Related (4)	.45*	.30	.97	11.18	3.24*	−9.08	−2.91	.47**
Drugs & Related (7)	.26	.38	.93	−4.52	−1.17	6.04	1.72	.21
Petroleum Refining (7)	.60*	.58*	.98	6.95	.99	−2.91	−.40	.37**
Tires & Rubber (2)	−.36	−.42	.79	−.34	−.24	−.85	−.95	.18
Stone, Clay, Glass (8)	.18	.19	.92	.19	.07	.48	.23	.04
Steel (4)	.42*	.42*	.99	.40	.17	.32	.14	.18
Nonferrous Metal (4)	.07	.07	.98	−.02	−.01	.17	.07	.01
Machinery (3)	.27	.55*	.78	−3.76	−1.29	7.72	2.80*	.37**
Business Machines (4)	−.05	−.08	.91	1.44	.21	−1.91	−.33	.01
Electrical (2)	.47*	.30	.92	9.53	2.52*	−6.14	−1.72	.34**
Home Appliances (4)	.48*	.38	.93	7.51	1.62	−4.28	−.84	.26***
Autos (3)	.64*	.60*	.98	1.18	1.24	−.48	−.57	.41**
Aircraft (2)	.29	.31	.98	−1.04	−.32	2.36	.60	.10
Instruments & Related (4)	.00	−.10	.89	6.42	.86	−7.90	−.96	.05
Airlines (6)	.27	.23	.97	1.77	.79	−1.12	−.53	.09
Utilities (10)	.06	.09	.92	−.91	−.25	1.53	.38	.01
Retail Stores (7)	.54*	.50*	.93	3.44	.95	.08	.03	.29***
Grocery Stores (3)	.38	.10	.43	3.31	1.65	−.26	−.29	.15
Banking (5)	.21	.15	.97	5.65	1.11	−3.87	−.92	.09
Other Financial (2)	.14	.08	.85	3.07	.53	−1.28	−.26	.02
Consumer Services (3)	.21	.20	.99	2.45	.18	−1.66	−.12	.04
Sample mean	.27	.26	.89	2.35	.53	−.87	−.13	.18

[a] Each regression is based on time series of 19 annual industry means. All data are expressed in terms of deviations from annual overall sample mean.

* Significantly greater than zero, .05 level (one-tailed test).

** Overall explanatory power significant at the .05 level. Note that since this significance test does not take the sign of the relation between returns and unexpected income into account, Corr(R, UHC) and Corr(R, UCC) can both be significantly greater than zero at the .05 level (one-tailed test), while the overall explanatory power of the regression is not significant at the .05 level.

*** Overall explanatory power significant at the .10 level. (See note immediately above.)

(1) is estimated with these data, the analysis focuses on whether the income measures explain the industry-specific component of time-series variation in returns. Supplemental analyses based on data in raw form are also provided, to establish a better basis for comparison with Beaver et al. [1982].

III. EMPIRICAL RESULTS

Primary Analysis: Time-series Regressions by Industry

Overview of the 27 Industries. Table 2 summarizes simple time-series correlations between returns, *UHC*, and *UCC*, as well as the time-series regressions for each of the 27 industries included in the sample. On average across industries, neither *UHC* or *UCC* dominates in terms of the degree of association with stock returns. The average correlation between returns and *UCC* is .26; the average correlation between returns and *UHC* is .27. Although these correlations may seem to be low, they are comparable to those obtained in cross-section by prior researchers and are higher than most estimates obtained in time-series by Easman et al. [1979] and Beaver et al. [1982].[11] Nevertheless, only 19 time-series observations support each estimate and the correlations are significantly greater than zero (.05 level, one-tailed test) for only ten industries for *UHC* and eight for *UCC*.

The average correlation between the two measures of unexpected income is quite high (.89). In 23 of the 27 industries, the correlation is higher than .80, indicating that *UHC* and *UCC* are conveying similar information. The high degree of collinearity has three implications for the multiple regressions.

First, the combination of *UHC* and *UCC* in the multiple regression will tend to offer little more explanatory power than either variable alone. Second, although the coefficient estimates will be unbiased and the *t*-statistics valid, it is unlikely that *t*-statistics for either *UHC* or *UCC* will be statistically significant for many industries. The *t*-statistics provide an indication of the *incremental* explanatory power of *UHC* and *UCC*, not total explanatory power. For example, for the textiles/apparel industry, both *UHC* and *UCC* have a significant simple correlation with returns, and the overall explanatory power of the regression is significant. Nevertheless, because *UHC* and *UCC* are very highly correlated (.97), neither variable offers *incremental* explanatory power, and *t*-statistics are close to zero for both. Across all industries, the incremental explanatory power of *UHC* is significant in only three cases; *UCC* offers significant incremental explanatory power only once.

Third, the high positive correlation between *UHC* and *UCC* will tend to induce a high negative correlation between estimation errors in the coefficients for the two variables. Thus, even if the underlying parameters for both *UHC* and *UCC* were positive, these estimation errors could frequently cause the *estimated* coefficient to be negative for one of the two variables. This explains the frequency of negative estimated coefficients for *UHC* and *UCC*; in 23 of the 24 industries where a negative coefficient occurs for one of these variables, the remaining coefficient is positive. (Since no theoretical basis exists for expecting a parameter with a negative sign, a one-tailed test is used and thus none of the negative estimated coefficients are considered statistically significant.)

Clearly, the movement to a time-series framework has not mitigated the high degree of collinearity between *UHC* and *UCC* for the vast majority of industries. In those industries, *UHC* and *UCC* are nearly equivalent measures of income, so there is little potential for either to offer incremental information content.

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[11] Beaver et al. [1979, Table 8] report average cross-sectional rank correlations between returns and unexpected historical cost income ranging from .32 to .38. Beaver and Ryan [1985] report simple cross-sectional correlations between returns and unexpected current cost income from operations ranging from .30 to .35. Similar estimates for unexpected historical cost income ranged from .30 to .48. These estimates were all derived using firm-specific data.

On the basis of time-series analyses, Easman et al. [1979] report an average correlation of .12 between variables corresponding to *R* and *UHC*, and .19 for variables corresponding to *R* and *UCC*. Using somewhat different measures of the same variables, Beaver et al. [1982] obtain average correlations of .07 (.43) between *R* and *UHC* (*UCC*).

Industry Subsets. We now ask whether significant incremental information exists in industries where *UHC* and *UCC* are not highly correlated. Even though the correlation between *UHC* and *UCC* is extremely high on average, it is as low as .40 in some industries. This subsection examines the subset of four industries where the correlation between *UHC* and *UCC* is less than .80.[12]

In addition to focusing attention on industries where the potential for incremental information content is greatest, the examination of only a subset of industries makes Zellner's seemingly unrelated regression analysis feasible. This technique should improve the efficiency of estimation. It also permits tests of hypotheses concerning each of the industries in the subset simultaneously, while explicitly recognizing dependence across industries. (This approach cannot be applied when all industries are considered, because not enough time-series data are available to estimate a nonsingular residual covariance matrix for a system of that size.)

Seemingly unrelated regression results are presented in Panel A of Table 3. Among the four industries with the lowest degree of collinearity, only one (grocery stores) has a coefficient for *UHC* that is positive, and even it is not statistically significant. On the other hand, the coefficients for *UCC* are positive for three of the four industries. One industry (machinery) has a coefficient for *UCC* that is both positive and significant.

The *t*-statistics in Panel A of Table 3 provide a basis for making inferences about one industry at a time. However, since the four industries do not represent independent units, it is difficult to assess the degree to which the overall evidence is consistent with the null. That is, the coefficients and *t*-statistics in the four separate regressions may or may not be simultaneously consistent with the null, depending on the patterns of dependence among the industries. Therefore, two additional procedures were used to test the hypothesis that a given income variable provides no incremental information content for any industry. The specific null being tested is that the coefficients of *UHC* (or *UCC*, in a separate test) are simultaneously equal to zero for all industries. These tests are reported in Panels B and C of Table 3. The first test procedure is based on Theil's *F* (Theil [1971, equation 3.6], or Judge et al. [1980, equation 6.1.15]). Results indicate that the null hypothesis can be rejected at only the .09 level for *UHC*, but for *UCC*, the null can be rejected at the .01 level.

A limitation of Theil's *F* is that, except in highly specialized cases, its sample properties are known only asymptotically.[13] Given the relatively short time-series used here, it is possible that the significance levels indicated by Theil's *F* could be severely misstated. Therefore, a parametric bootstrap technique (summarized

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[12] The cutoff point of .80 was chosen so that the number of industries examined simultaneously would never exceed the maximum for which seemingly unrelated regression estimation would be feasible, while maintaining certain desirable properties in the estimated residual covariance matrix. With only 19 time-series observations, the estimated covariance matrix possesses undesirable properties when the number of industries exceeds eight (see Schipper and Thompson [1983, p. 199]). A cutoff of .80 calls for inclusion of eight industries when the data are analyzed in raw form (see the subsequent section) and four industries when the data are analyzed in deviation form. It would also be feasible to analyze eight industries using data in deviation form if the cutoff were raised to .89 for those tests; however, such a high cutoff was viewed as inconsistent with the intent to focus on industries with "low" correlation.

[13] In certain special cases, one can use Rao's *F*, for which finite sample properties are known exactly, or a close approximation. Rao's *F* has been used in other accounting research (see Hughes and Ricks [1984]; Binder [1985]; and Schipper and Thompson [1985]). However, the context examined here is not among the special cases for which an exact test is available.

TABLE 3

ANALYSES OF INDUSTRIES WITH "LOW"[a] CORRELATION BETWEEN UNEXPECTED HISTORICAL COST (*UHC*) AND UNEXPECTED CURRENT COST (*UCC*) INCOME: DATA EXPRESSED AS DEVIATIONS ABOUT ANNUAL SAMPLE MEAN

A. Seemingly Unrelated Regression Estimates:

Industry (Number of firms)	*Corr*(UHC, UCC)	UHC *Coefficient*	UHC t-*value*	UCC *Coefficient*	UCC t-*value*
Soda, Candy (5)	.40	−1.15	−.50	.45	.45
Tires & Rubber (2)	.79	−.34	−.25	−.97	−1.09
Machinery (3)	.78	−6.75	−2.76	10.56	4.74*
Grocery Stores (3)	.43	1.76	1.02	.32	.44

B. Test of Hypothesis of
No Incremental Information Content for Any Industry: Theil's F

Variable	F-*statistic*	*Significance Level*
UHC	2.13	.09
UCC	6.62	.00

C. Test of Hypothesis of
No Incremental Information Content for Any Industry: Bootstrap Technique

Variable	*Bootstrap* p-*value*
UHC	.23
UCC	.01

[a] "Low" is defined to be less than .80.
* Significantly greater than zero at .05 level (one-tailed test).

in the Appendix) was used to determine how frequently, under the null, one would observe *F*-statistics as large as those calculated here. This frequency is denoted as the bootstrap *p*-value in Table 3. The bootstrap *p*-values indicate that one could reject the hypothesis of zero coefficients for all four industries at only the .23 level for *UHC*. In contrast, for *UCC* the null can still be rejected at the .01 level. It seems that among those industries where *UHC* and *UCC* are least correlated, evidence of incremental information content exists for *UCC*, but there is little or no evidence of incremental information in *UHC*.

Rejection of the hypothesis of zero coefficients of *UCC* for all four industries is the strongest evidence presented here that current cost income may convey incremental information content. However, any conclusions from this evidence must be drawn cautiously, because rejection is probably attributable primarily to the effect of the coefficient for one industry (machinery).[14] Moreover, the result can at best apply only to the subset of industries where the degree of correlation between *UHC* and *UCC* is relatively low, and that correlation has already been shown to exceed .80 for most industries.

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[14] Since the maximum permissible correlation between *UHC* and *UCC* in these tests (.80) may be perceived as "too high," the tests were repeated with lower cutoff values, thus including fewer than four industries. When the cutoff was reduced enough to exclude "tires and rubber" and "machinery," it was not possible to reject the null of no incremental information content for either

Supplemental Analyses

Time-series Analyses Based on Data in Raw Form. Recall that Beaver et al. [1982] find indications that current cost income from continuing operations may provide incremental information content in a time-series analysis, even though none is evident in a cross-sectional analysis. Some supplemental tests were conducted to further assess whether that indication (based on only six observations per firm) holds in this larger data set.

The Beaver et al. [1982] time-series analysis was based on simple correlations between stock returns and scaled changes in alternative income measures. Since the data were used in raw form (as opposed to deviations about annual sample means or a market index), they reflect both firm-specific and market-wide variation. Beaver et al. speculated that it may be the market-wide component of the variation that provides the apparent incremental information content in current cost data. That is, stock returns are known to be negatively correlated with unexpected inflation for most firms [Bernard, 1986]. Since the unexpected market-wide component of current cost adjustments to earnings is also negatively correlated with unexpected inflation, those current cost adjustments tend to be positively correlated with stock returns.

To examine this issue, the time-series tests were repeated while expressing all data (*R*, *UHC*, and *UCC*) in raw form. Tests that account explicitly for cross-sectional dependence in the data were included. Such tests are crucial in this context, since market-wide swings in the data can induce a high degree of dependence across firms, and so (as Beaver et al. suggest in discussing their results) tests that do not account for the dependence are difficult to interpret.

Table 4 summarizes the tests. Test procedures are identical to those used to generate Table 3, and are based on eight industries where the correlation between *UHC* and *UCC* is less than .80 when the data are retained in raw form. Panel A of Table 4 shows that the coefficients of *UHC* are positive for seven of the eight (non-independent) industries, and that five of the eight coefficients are statistically significant at the .05 level, using a one-tailed test. The coefficients of *UCC* are positive for each of the eight (non-independent) industries, including four that are statistically significant. Thus, before taking into account cross-sectional dependence in the data, both *UHC* and *UCC* appear to be important explanatory variables.

Panels B and C of Table 4 summarize tests that explicitly account for cross-sectional dependence. The null hypothesis of no incremental information for any of the eight industries can be rejected for both *UHC* and *UCC* at the .01 level, using Theil's *F*. However, the bootstrap estimates, which do not rely on the asymptotics underlying Theil's *F*, confirm a rejection of the null only for *UHC*. For *UCC*, the bootstrap technique indicates that a value for Theil's *F* as large as that observed in these data could occur by chance 37 percent of the time even when the null is true. That frequency contrasts sharply with the indi-

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UHC or *UCC*. Given the information in Table 3, this is expected since the remaining two industries, "soda and candy" and "grocery stores," have coefficients for both *UHC* and *UCC* that are close to zero.

TABLE 4

ANALYSES OF INDUSTRIES WITH "LOW"[a] CORRELATION BETWEEN UNEXPECTED HISTORICAL COST (*UHC*) AND UNEXPECTED CURRENT COST (*UCC*) INCOME: DATA EXPRESSED IN RAW FORM

A. Seemingly Unrelated Regressions:

Industry (*Number of firms*)	*Corr*(UHC, UCC)	UHC *Coefficient*	UHC t-*value*	UCC *Coefficient*	UCC t-*value*
Foods (3)	.73	4.20	1.08	3.72	2.89*
Soda, Candy (5)	.10	−.33	−.10	1.95	2.20*
Drugs & Related (7)	.62	13.01	3.63*	.59	.15
Machinery (3)	.69	3.29	1.05	4.60	1.96*
Business Machines (4)	.65	10.08	2.38*	1.45	.43
Instruments & Related (4)	.44	13.62	1.97*	6.49	.80
Utilities (10)	.49	6.46	3.99*	5.38	1.89*
Grocery Stores (3)	.18	3.94	1.98*	.46	.78

B. Test of Hypothesis of
No Incremental Information Content for Any Industry: Theil's F

Variable	F-*statistic*	*Significance Level*
UHC	5.84	.00
UCC	2.77	.01

C. Test of Hypothesis of
No Incremental Information Content for Any Industry: Bootstrap Technique

Variable	*Bootstrap* p-*value*
UHC	.03
UCC	.37

[a] "Low" is defined to be less than .80.
* Significantly greater than zero at .05 level (one-tailed test).

cated significance level of .01, and indicates the importance of not relying on the asymptotic theory of generalized least squares when the residual covariance matrix is estimated imprecisely.

After accounting for cross-sectional dependence, tests based on raw data provide little basis for rejecting the hypothesis of no incremental information content in *UCC*. Even though the coefficients of *UCC* are positive for each of the eight industries, the coefficients as a group do not appear to deviate significantly from zero, once the high degree of dependence in the data is considered.[15,16] If it were possible to account explicitly

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[15] In our bootstrap simulations of behavior under the null, each of the eight coefficients of *UCC* was positive only one percent of the time. Thus, even after taking cross-sectional dependence into account, it appears unusual that all eight coefficients of *UCC* were positive. The *F*-test used in the analysis does not directly consider this characteristic of the data. Since the *F*-test was chosen *ex ante* and the unusual frequency of positive coefficients was noted only *ex post*, we felt emphasis of the latter could constitute "data fishing." Thus, we maintain emphasis on the (bootstrapped) *F*-test.

[16] As in the primary analysis, additional tests were conducted while using lower cutoffs on the maximum permissible correlation between *UHC* and *UCC*. The

for the dependence in the Beaver et al. [1982] data, a similar conclusion might be reached.

Evidence of incremental information content in the *UCC* data is weaker in the supplementary tests than in the primary tests. The difference between the results could reflect (a) differences in the subset of industries used in the two tests, and/or (b) a reduction in power in the supplementary tests due to the additional (and potentially extraneous) variance in the raw data. It appears that both explanations play a role. When the same four industries analyzed in the primary tests were re-analyzed using raw data, the null of no incremental information content in any industry for *UCC* can still be rejected, but only at the .10 level. For *UHC*, the significance level is .09. (Significance levels are based on bootstrap procedures.)

Cross-Sectional Analyses. The data used in this study were also analyzed by regressing stock returns against *UHC* and *UCC* in a cross-section for each year, 1962–1980. Regressions were estimated using both firm-specific data and industry data. There was some evidence of incremental information content in the historical cost data, but not in the current cost data (see Bernard and Ruland [1986] for details). Thus, to the extent that the primary analyses presented here are indicative of incremental information content in the current cost data, it appears that the use of a time-series approach is important.

Alternative Inflation-Adjusted Income Measures. Tests were also conducted where the measure of current cost income was augmented with gains/losses on changes in the value of the net monetary position. The evidence of French, Ruback, and Schwert [1983] and Bernard [1986] indicates that such gains and losses are small, relative to other factors that affect stock returns. The results here are consistent with that evidence. That is, the results are altered little by the inclusion of the gain/loss on the net monetary position, and evidence of incremental information content in current cost income is, if anything, weaker.

IV. CONCLUSIONS AND IMPLICATIONS

This paper has focused on issues discussed frequently in prior research but that could not be analyzed heretofore due to the lack of sufficient time-series data. Specifically, we examined the incremental information content of historical cost and current cost data in a time-series framework, where the implicit valuation model can vary across industries. Time-series analyses were conducted for 27 industries over the period 1962 to 1980.

Some evidence of incremental information content in current cost data was found in time-series regressions for industries where the correlation between unexpected current cost income and unexpected historical cost income is lowest. However, the results must be interpreted with caution, since they may apply (at best) to only a small subset of industries. Even though incremental information in current cost data is more evident in a time-series analysis than in a cross-sectional analysis, it is still not strong. Thus, the reluctance of Beaver et al. [1982] to draw firm conclusions from their analysis of a shorter time-series appears warranted.

The results also indicated that the degree of collinearity between unexpect-

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null hypothesis of no incremental information content in *UHC* was still rejected at the .05 level (using the bootstrap p-value), so long as the cutoff retained at least four industries in the analysis. The same hypothesis for *UCC* could not be rejected at the .05 level for any number of industries.

ed historical cost and current cost income measures is extremely high for most industries. This indicates that across a variety of economic contexts, the two measures convey much the same information. For most industries, adjustments to reflect unexpected changes in current costs are dominated by other sources of variation in profitability.

Finally, the results have provided some evidence concerning methods. Bootstrap estimates presented here suggest that significance levels based on standard hypothesis tests from generalized least squares routines can be dramatically understated. The evidence is consistent with and complements that generated by Marais [1986] within the context of a regulatory event study.

APPENDIX

This appendix describes procedures used to obtain bootstrap *p*-values for tests of the hypothesis that given coefficients are equal to zero for a subset of industries. A good description of bootstrap methods used within the context of seemingly unrelated regression can be found in Marais [1986]. The problem faced here differs in important respects from that of Marais, and so the procedures used here are described in some detail.

The goal of the bootstrap procedure used here is to estimate the probability of obtaining a given test statistic in a hypothesis test, given that the null is true. The test statistic (Theil's F) is distributed as an F (under the null) asymptotically, but may not be distributed as such in a finite sample. The essence of the procedure is to generate many independent sets of "pseudo-stock returns" that conform to the model assumed under the null hypothesis and which reflect the same degree of cross-correlation and cross-sectional heteroscedasticity as observed in the original data. For each set of "pseudo-stock returns," a test statistic is generated, using the same procedures used to calculate Theil's F. It is then determined how frequently one observes values of the test-statistic as large as that actually observed in the original hypothesis test.

The procedure is described for tests of the null that the coefficients of *UCC* are equal to zero for each industry; the procedure applied to coefficients of *UHC* is analogous.

Note that under the null, the true relation between the stock return metric R and the independent variables *UHC* and *UCC* would not include *UCC*:

$$R_{it}=a_i+b_{1i}(UHC_{it})+e_{it} \qquad i=1,2,\ldots N; \quad t=1,2,\ldots T \tag{A1}$$

where all variables are as defined in the main text.

The above equation is estimated for each industry included in the test. Estimates for this equation are denoted as $\hat{a}_i$, $\hat{b}_{1i}$, and $\hat{e}_{it}$. Using the ($N\times T$) matrix of sample values e_{it}, the residual covariance matrix is estimated, as is done in the first stage of a seemingly unrelated regression procedure. The next step is to create "many" (100–200) sample ($N\times T$) matrices of "pseudo-residuals," which are generated from a multivariate normal distribution with zero means, and with remaining parameters defined by the estimated covariance matrix. (The *IMSL* routine *GGNML* was used to accomplish this task.) These "pseudo-residuals" are denoted by e^*_{it}. For each set of "pseudo-residuals," "pseudo-stock-returns," R^*_{it}, are created as follows:

$$R^*_{it} = \hat{a}_i + \hat{b}_{1i}(UHC_{it}) + e^*_{it} \tag{A2}$$

Finally, to determine how estimates of the regression equation used in the primary hypothesis tests might behave under null, each set of "pseudo-stock-returns" is regressed against *UHC* and *UCC*, using seemingly unrelated regressions. These estimates are identified with the symbol $\hat{\hat{\ }}$:

$$R^*_{it} = \hat{\hat{a}}_i + \hat{\hat{b}}_{1i}(UHC_{it}) + \hat{\hat{b}}_{2i}(UCC_{it}) + \hat{\hat{e}}_{it} \tag{A3}$$

The number of sets of "pseudo-stock-returns," and thus the number of estimates of equation (A3), was 200 in the primary tests and 100 in the supplementary tests. Theil's F is calculated for each estimate, and an empirical distribution of these test statistics is formed. The single test statistic calculated in the original test is compared with this empirical distribution to obtain the bootstrap p-value.

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The Incremental Information Content of Accrual Versus Cash Flows

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ABSTRACT: Current financial reporting practices have traditionally emphasized measures of accrual earnings. On the other hand, the link between future cash flows and firm value is well accepted by financial economists, and recently there has been increased interest in measures of cash flow. This paper provides evidence on the role of accrual (i.e., earnings and working capital from operations [*WCFO*]) and cash flow measures in an explanatory model of security prices. This issue is first examined by testing for an association between unexpected security returns and unexpected cash flows, after controlling for the relation between unexpected returns and unexpected earnings. We also examine the obverse issue by testing for an association between unexpected security returns and unexpected earnings, after controlling for the relation between unexpected returns and unexpected cash flows. We test these relations in two contexts: in results pooled over the entire ten-year time period studied and in year-by-year cross-sectional regressions. Results for our complete sample are generally consistent with: (1) cash flow data having incremental information content relative to that contained in earnings; (2) cash flow data having incremental information content in addition to that contained in earnings and *WCFO*; and (3) accrual data (i.e., earnings and *WCFO*) jointly and separately having incremental information content in addition to that contained in cash flow data. However, the results do not support the hypothesis that *WCFO* has incremental information content relative to that contained in earnings.

THE onset of higher interest rates and more frequent business failures in the 1970s was accompanied by increased concern over the usefulness of accrual accounting numbers relative to cash flow data. Recently, the Financial Accounting Standards Board (FASB) [1986] has addressed this concern by proposing that the Statement of Changes in Financial Position (SCFP) be replaced by a Cash Flow Statement. The increased emphasis on the more primitive concept of cash flows is a departure from the current institutional environment in which accrual accounting pre-

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dominates. The role of cash flow data in decisions of financial statement users can be viewed from two perspectives. The first, which we label the "institutional perspective," takes the traditional accrual accounting system as given and asks whether cash flow data (defined later) add to the information already provided by accrual data. The second (and opposite) perspective views cash flows to be the primitive concept and asks whether modifications introduced by the accrual accounting process add to the underlying cash flow information.

Relying on the initial institutional perspective, the first purpose of this paper is to investigate whether cash flow data (defined later) add to the information set impounded in security prices.[1] We address this issue by testing for an association between unexpected cash flows and unexpected returns to equity securities, after controlling for the well-established relation between unexpected stock returns and unexpected earnings. In other words, this study reports tests of the incremental information content of unexpected cash flow data beyond the information provided by earnings.[2] We also test for incremental information content in cash flow data relative to an expanded set of accrual data composed of both earnings and working capital from operations (*WCFO*).

A second purpose of this paper is to examine the incremental information content issue from the opposite perspective; that is, to investigate whether the accrual process adds to information contained in cash flow numbers. The current financial reporting environment emphasizes accrual flow measures. However, future cash flows are the attributes of concern in economic models of firm value. Given the higher costs of producing and auditing financial statements for accrual systems, it seems reasonable to also address the issue of the incremental benefit of accrual data. Therefore, we also test for an association between unexpected earnings and unexpected security returns after controlling for the relation between unexpected cash flow and unexpected returns.

The paper is organized as follows. Section I reviews research on the information content of cash flow data and develops the hypotheses of interest. In section II, we define measures of unexpected cash flow, earnings, and returns. Section III presents the empirical models used to test the hypotheses. Results are presented in section IV and the paper closes with a summary in section V.

I. HYPOTHESIS DEVELOPMENT

Authoritative Positions on the Informativeness of Cash Flow Data

The accounting literature contains assertions that earnings, and not cash flow, should be reported by the accounting system. Typical of the arguments which suggest that accrual-based income is preferable to cash basis data is the FASB [1978] contention that financial reporting should focus on earnings as opposed to cash flows:

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[1] There are many other decision contexts where cash flow data might be used. For example, in a failure prediction context, Casey and Bartczak [1984] find that the addition of cash flow data did not improve the ability to discriminate failed from non-failed firms.

[2] While authoritative accounting bodies have taken the position that accrual accounting earnings provides superior predictions of future cash flows, this paper does *not* address the question of which system, cash or accrual, is superior. Rather, we address the issue: Does one system add to the information provided by the other?

> Information about enterprise earnings based on accrual accounting generally provides a better indication of an enterprise's present and continuing ability to generate favorable cash flows than information limited to the financial aspects of cash receipts and payments [p. ix].

Although many accountants contend that accrual-based earnings are a more important signal, few would suggest that cash flows have no information content. For example, Health [1978], in his monograph on reporting for solvency, concludes that there is a need for more concern over short-term solvency (i.e., cash flow), and that provision of this data through the formal reporting system may be useful.

Research Prior to 1986

At least three studies provide evidence on the information content of net income plus depreciation and amortization, which has often been used as a surrogate for cash flow.[3] Ball and Brown [1968] report stronger evidence of the information content of earnings than of the information content of the cash flow surrogate. Similarly, Beaver and Dukes [1972] report stronger correlations between abnormal returns and unexpected accrual-based earnings (either with or without the inclusion of deferred taxes) than between abnormal returns and the surrogate for unexpected cash flow. However, this evidence is only indirectly relevant since comparisons of abnormal performance (as in Ball and Brown) or comparisons of correlations (as in Beaver and Dukes) do not constitute tests of *incremental* information content.

Beaver et al. [1982, p. 30] report some additional explanatory power (relative to historical cost earnings) for percentage changes in net income plus depreciation and amortization. However, they are cautious in their interpretation of this finding and state that the "performance (of the 'cash flow' variable) is an open issue" (p. 34).

Patell and Kaplan [1977] examine the incremental information content of cash flow data using percentage changes in working capital from operations as a measure of unexpected cash flow. Patell and Kaplan define abnormal returns using the market model, and then apply a procedure for testing incremental information content similar to that used by Gonedes [1975, 1978]. They are unable to reject the null hypothesis that unexpected cash flows are unrelated to unexpected returns, after conditioning the unexpected return on unexpected earnings. They note that the correlation between earnings and working capital from operations is quite high, and that this correlation remains high when the earnings and cash flow series are converted to percentage changes.[4]

Hypotheses

These earlier market association studies generally failed to detect incremental information content in "cash flow" data. Failure to detect significant information content in a market association test can be caused by one or more of five factors: (1) the cash flow variable used by the market is poorly measured in the study; (2) the expectation of the cash flow variable used by the market is poorly specified, so that unexpected cash flow is poorly measured; (3) unexpected returns are poorly measured; (4) the time period over which the data are impounded in market prices is incorrectly specified; or (5) cash flow information does not possess incremental information content. Since previous studies have failed to detect information content, new association tests must be designed to minimize the probability that any of the first four reasons listed above lead to a failure to detect incremental information content.

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[3] After beginning this project, we became aware of other contemporaneous research on this issue (i.e., Rayburn [1986] and Wilson [1986, 1987]). These papers are discussed after introducing our hypotheses in the next section.

[4] Christie et al. [1984] note that it is extremely difficult to disentangle the relative explanatory power of highly correlated independent variables, and argue that results which show insignificant incremental information content may be attributable to the problem of collinearity between *WCFO* and earnings. Bowen et al. [1986] also report that the cash flow surrogates used in these studies are highly correlated with net income across time.

This study reexamines the question of the incremental information content of cash flow data using an approach that differs from earlier studies in three major ways.[5] First, we calculate alternative measures of cash flow for each firm using the computational process defined in Bowen et al. [1986].[6] Bowen et al. report low correlation between percentage changes in alternative measures of cash flow and both percentage changes in earnings and percentage changes in traditional cash flow surrogates over the period 1971–1981. Thus, the alternative measures of cash flow examined in this paper have substantially different properties than the traditional cash flow measures used in earlier research. Moreover, the use of alternative measures of cash flow may mitigate some aspects of the collinearity problem discussed in Christie et al. [1984].

Second, we use a pooled cross-sectional and time-series regression approach to measure the relation between abnormal returns and the unexpected cash flow variables. The regression approach allows for tests of the relation between the magnitudes of unexpected cash flows and abnormal returns, conditioning for the magnitude of unexpected earnings. Thus, this study seeks to resolve some of the contradictory results of previous research by refining the measures and using procedures that may be more powerful than those used in earlier research.

Third, by restricting our sample to firms that reported funds from operations on a working-capital basis, we maintain a consistent definition of cash flows across firms. Further, our sample selection procedures allow for definitions of cash flow which minimize measurement error in the conversion process.[7] These issues are discussed more fully in section II.

The first alternative hypothesis of this study is:

H_1: Cash flow measures have incremental information content beyond that contained in contemporaneous accrual earnings data.

We also recast the issue and investigate whether accrual earnings data add to contemporaneous cash flow data. Thus, the second hypothesis is:

H_2: Accrual earnings numbers have incremental information content beyond that contained in contemporaneous cash flow data.

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[5] Contemporaneous research which also addresses some of these issues is discussed in the next section.

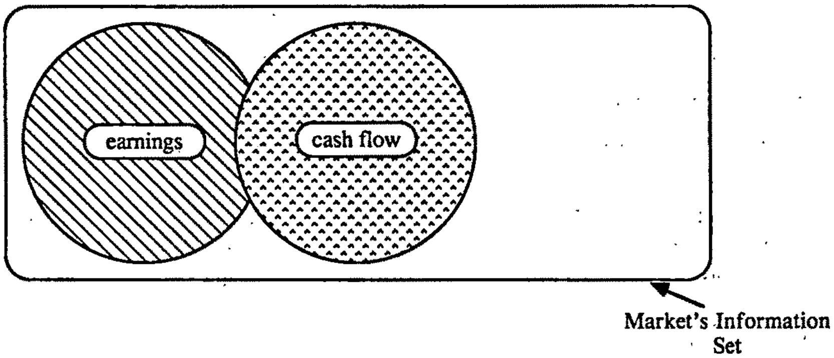
[6] This process is similar to those suggested by Casey and Bartczak [1984], Gombola and Ketz [1983], and Largay and Stickney [1980]. Note that no standard terminology exists for cash flow variables. For instance, Value Line refers to net income plus depreciation (*NIDPR*) as "cash from operations"; COMPUSTAT refers to both *NIDPR* and *WCFO* as cash flow variables; and the SEC and the FASB are wrestling with the problem of definitions for cash flow variables (see Greene [1984]). Finally, some firms refer to *WCFO* as "cash from operations" on their cash basis statement of changes in financial position (e.g., Fieldcrest Mills, The Allen Group). (The authors thank Pete Wilson for supplying these examples.)

[7] Given that the component changes in the cash account are not observable from publicly available data and that firms report the statement of changes in financial position using the indirect method, we are forced to approximate operating cash flow variables as described in section II.

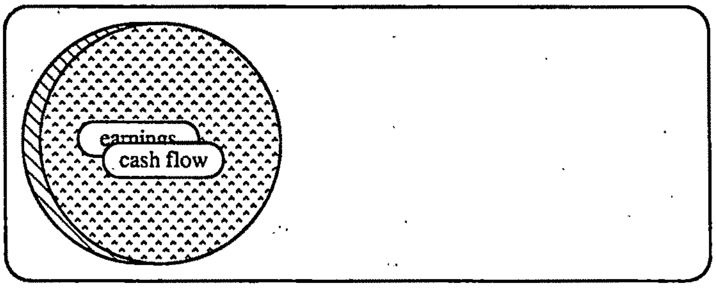
FIGURE 1

ALTERNATIVE OUTCOMES FOR A STUDY OF THE INFORMATION CONTENT IN CASH VERSUS ACCRUAL (E.G., EARNINGS) FLOWS*

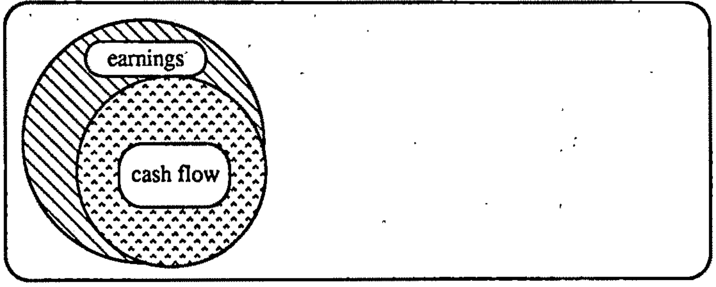
Panel A. Both Individually and Incrementally Important:



Panel B. Both are Individually Important, but Neither is Incrementally Important:



Panel C. Each Individually Important, but only One (e.g., Earnings) is Incrementally Important:



* The cases "Neither is Individually Important but both are Incrementally Important" and "Neither is Individually Important and Neither is Incrementally Important" are not depicted.

Figure 1 depicts possible outcomes from the above hypothesis tests. The large rectangle in each panel represents the market's available information set at a point in time. Panel A depicts the situation in which earnings and cash flow data are individually and incrementally important in that unexpected values of each have significant association with unexpected stock price changes. In Panel B earnings and cash flow variables are essentially substitutes for each other;

neither is incrementally important while each has significant association with unexpected stock price changes. Finally, Panel C depicts the situation in which one variable (e.g., earnings as shown) has incremental information content relative to the other but not vice versa.

Contemporaneous Research

At least three recent papers also investigate the incremental information content of cash flows versus accruals. Rayburn [1986] reports significant association between abnormal returns and both operating cash flows and aggregate accruals. There are several differences between her study and the analyses reported in this paper. First, the studies use different measures of cash flow from operations. We base our measure(s) of cash flow on those used in practice. Since Rayburn uses data prior to 1971 when the SCFP was not generally available, her measure of cash flow may contain more accruals and may be less exclusively related to "operations" than our measure of cash flow from operations.[8] Second, we consider a second measure of cash flow—cash flow after investment activities—which is used in practice,[9] and is also suggested by the FASB [1986] proposal that cash flows be divided into operations, financing, and investment in the new Statement of Cash Flows. Third, the incremental information content of cash flow data beyond that contained in earnings and *WCFO* is not explicitly examined in the Rayburn paper.

Wilson [1986, 1987] also investigates the relative incremental information content of accruals and cash flow data. Wilson [1987] investigates whether "accrual and funds" components of earnings released around the annual report/10-K SEC filing date have incremental information content beyond earnings. His results are consistent with the existence of incremental information content when funds are defined as cash flow from operations but not when funds are defined as working capital from operations. Wilson [1986] investigates the incremental information content of accruals beyond cash flows. He uses daily data to compare stock price reactions around the date the annual report arrives at the SEC to reactions at the earlier *Wall Street Journal* earnings announcement date. His results are consistent with the existence of incremental information in current (but not long-term) accruals beyond that contained in operating cash flow data alone.

This paper differs from Wilson's papers in the following respects. First, we use an annual event window up through the SEC filing month rather than using a short-event window consisting of the days surrounding the SEC filing. We chose an annual window because new cash flow information likely becomes available to the market throughout the year. For example, each quarterly report that includes balance sheet and/or a SCFP allows users to estimate operating cash flow information.[10] Second, we use different sample selection procedures, and as a result, examine fewer firms but more years (1972-81 versus 1981-82) than does Wilson. Third, because percentage changes may be easier to interpret and because they are used by analysts, we scale the independent variables to obtain percentage changes.[11]

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[8] This is consistent with the high correlations between the cash flow and accrual variables reported in her Table 4. More precisely, she defines "operating cash flows" to be: earnings before extraordinary items plus the change in working capital (except current maturities of long-term debt); the change in deferred taxes; and depreciation, amortization, and depletion. In contrast, our measure of cash flow from operations begins with all adjustments normally made to arrive at working capital from operations, yet excludes changes in other current liabilities not related to operations (e.g., notes payable). See section II for details on the measurement of our variables.

[9] For example, Robert Morris Associates [1982] defines a measure of cash flow after financing that is similar to our definition in section II.

[10] In fact, Wilson [1987] reports some evidence of an "early" reaction to cash from operations.

II. VARIABLE DEFINITIONS AND SAMPLE SELECTION

This section comprises four subsections. In the first subsection, we define two major accrual measures disclosed in financial reports and two measures of cash flow not directly produced by firms but advocated recently in the literature. In the next two subsections, expectations models for *unexpected* operating flows and unexpected returns are defined. Sample selection procedures are described in the last subsection.

Measures of Accrual Flows and Cash Flows

Accrual-Based Measures. Because cash flow numbers were not directly produced by firms in our sample, we begin with earnings and construct increasingly complex estimates of the unobservable underlying operating cash flow numbers. The first accrual-based measure is earnings:

$NIBEI$ = Net income before extraordinary items and discontinued operations (COMPUSTAT Item No. 18).[12]

In response to demand for additional data on the liquidity position of firms, the Statement of Changes in Financial Position (SCFP) was required beginning in 1971. Until very recently, working capital was the dominant definition of funds in the SCFP.[13] Working capital from operations (*WCFO*) is a second widely-used accrual operating flow that incorporates adjustments to net income for items not affecting working capital. These adjustments commonly include the removal of depreciation and amortization but also may include adjustments for gains and losses on asset sales, gains and losses on investments accounted for by the equity method, amortization of bond premiums or discounts, and deferred taxes. Thus, *WCFO* is defined as:

$WCFO = NIBEI +$ adjustments for elements of NIBEI not affecting working capital

where

$WCFO =$ COMPUSTAT Item No. 110.

Measures of Cash Flow. We refer to the next two variables as measures of cash flow.[14] Cash flow from operations (*CFO*) adjusts working capital from operations for changes in working capital accounts related to operations (other than cash). Cash flow after investment (*CFAI*) adjusts *CFO* for the year's net investment activity.

Largay and Stickney [1980] considered measures of cash flow that incorporated additional adjustments to *WCFO*. These measures were compared with net income and working capital from operations as lead indicators of the W. T. Grant Company bankruptcy. Gombola and Ketz [1983] considered similar measures of cash flow in a study of the role of cash flow data in ratio analysis. In both studies, these measures of cash flow were developed by adjusting *WCFO* using certain changes in financial statement accruals to adjust working capital from operations to a cash basis.[15] We use a similar procedure below to define cash flow from operations using changes in non-cash current assets and current liabilities (other than cash, notes payable, and the current portion of long-term debt), obtained from changes in individual accounts on the COMPUSTAT files:[16]

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[11] However, Wilson's results were robust to four different scalars.

[12] Each variable discussed in this section implicitly has a firm/time subscript which has been omitted for expositional convenience.

[13] *Accounting Trends and Techniques* reports a shift away from the working capital basis. For example, 95 percent used a working capital definition of funds in 1973 versus 48 percent in 1983.

[14] No authoritative body has yet institutionalized definitions of cash flows (see Lunzer [1986]). For example, the business media commonly refer to net income plus depreciation (*NIDPR*) as "cash flow" while we have labelled *WCFO* (which incorporates more adjustments to earnings than does *NIDPR*) an accrual measure. Because of the extremely high correlations between *NIDPR* and *WCFO* (see Bowen et al. [1986]), we include only *WCFO* in the empirical tests.

$$\begin{aligned} CFO &= WCFO - \Delta\text{non-cash current assets from operations} + \Delta\text{current liabilities from operations} \\ &= WCFO - \Delta REC - \Delta INV - \Delta OCA + \Delta AP + \Delta TP + \Delta OCL \end{aligned}$$

where

ΔREC = change in accounts receivable during the period (Item No. 2),

ΔINV = change in inventories during the period (Item No. 3),

ΔOCA = change in other current assets during the period (Item No. 68),

ΔAP = change in accounts payable during the period (Item No. 70),

ΔTP = change in taxes payable during the period (Item No. 71), and

ΔOCL = change in other current liabilities during the period (Item No. 72).

Each adjustment to *WCFO* reflects an alteration necessary to convert an income statement accrual (e.g., revenues) to the associated cash basis measurement (e.g., by removing the change in receivables to approximate cash collected from customers).[17]

Since cash flow after investment (*CFAI*) is an important component in many firm valuation models (e.g., see Fama and Miller [1972, p. 87]) and is discussed in the business media as one of the "basic definitions for cash flow" [Lunzer, 1986, p. 74], we adjust *CFO* for the period's investment activities to arrive at *CFAI*, but before financing:

$$CFAI = CFO + PSPPE + PSI + \Delta PPE + \Delta INVMT$$

where

$PSPPE$ = proceeds from the sale of property, plant and equipment (COMPUSTAT Item No. 107),

PSI = proceeds from sale of investments (Item No. 109),

ΔPPE = amount of capital expenditures during the period (Item No. 128), and

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[15] In the mid-1970s a similar approach to the conversion of accrual data into cash flow data was adopted by Wells Fargo Bank for their "Uniform Credit Analysis" training program for lending officers. A current version of this program is available from Robert Morris Associates [1982].

[16] Like Largay and Stickney [1980] and Robert Morris Associates [1982], but unlike Gombola and Ketz [1983], our definition excludes changes in notes payable and the current portion of long-term debt under the premise that these relate more to financing activities than to operations. As in all previous studies, because of data limitations, we make no attempt to adjust for changes in long-term accounts related to operations such as long-term receivables.

[17] A line-by-line cash-basis equivalent to the income statement would require more data than are available from COMPUSTAT or in corporate financial statements. For example, a detailed conversion of revenues to cash collected from customers must adjust for items such as progress payments and other advances from customers in addition to changes in current and long-term accounts receivable.

$\Delta INVMT$ = increase in investments in other corporations during the period (Item No. 129).

Models of Unexpected Operating Flows

Unexpected Accrual Flows. Unexpected earnings is defined as the percentage change in earnings from the previous period (where the "U" prefix on the variable indicates "unexpected").[18]

$$UE_{it} = (NIBEI_{it} - NIBEI_{it-1}) / |NIBEI_{it-1}|$$

where

$NIBEI_{it}$ = net income before extraordinary items for firm i in period t.

This definition assumes a martingale process for the expected level of net income before extraordinary items.[19] The expectations model is consistent with previous research into the information content of earnings (e.g., Ball and Brown [1968] among others), and with evidence on the time-series properties of accounting income (e.g., Ball and Watts [1972]). In addition, both Patell and Kaplan [1977] and Bowen et al. [1986] find that these definitions of unexpected earnings and cash flows result in the lowest correlation between the two variables. In Bowen et al. [1986], the correlation over time between unexpected earnings and cash flows variables measured in this fashion was generally not significant for the firms studied, suggesting that these measures may provide different information.

Previous studies have assumed that percentage changes in other accrual flows (i.e., *NIDPR* and *WCFO*) behave as a martingale process (e.g., see Ball and Brown [1968], Beaver and Dukes [1972], Beaver et al. [1982], and Patell and Kaplan [1977]). Evidence in Bowen et al. [1986] is consistent with this assumption and thus we define unexpected *WCFO* to be:

$$UWCFO_{it} = (WCFO_{it} - WCFO_{it-1}) / |WCFO_{it-1}|$$

Unexpected Cash Flows. Bowen et al. [1986] compare several expectations models for *CFO* and *CFAI* and reach three conclusions: (1) simple "random walk-type" models perform as well as more complex time-series or univariate regression models; (2) last period's *WCFO* is a better predictor of next period's *CFO* than either last period's *CFO* or earnings; and (3) for *CFAI*, a martingale model predicts as well as other models considered. Relying on this research, we define the following measures of deflated unexpected "cash flows":

$$UCFO_{it} = (CFO_{t} - WCFO_{it-1}) / |WCFO_{it-1}|$$

$$UCFAI_{it} = (CFAI_{it} - CFAI_{it-1}) / |CFAI_{it-1}|$$

Unexpected Returns

To define an abnormal return for an event period, decisions must be made about the event period length and the measure of expected return during the event period. Again, we choose an annual (as opposed to a daily or weekly) event period for the following reasons: (1) as with earnings, considerable cash flow data likely becomes available to market participants throughout the fiscal year; (2) conversions to more refined measures of cash flow are not practical for shorter time periods; and (3) a daily or weekly return window following the annual *earnings* announcement may be unable to detect incremental information from cash flow data merely because the accrual data "trickle" into the public domain until the release of the annual report or 10-K.

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[18] Christie [1987] argues for end-of-the-previous-year market value as the appropriate deflator under many conditions. However, Biddle and Lindahl [1982, Table 4] consider two deflators: last period's value of the series and the beginning of the period market value of equity. They found their results were not sensitive to the choice of deflators although the explanatory power (R^2) of the model increased by more than 40 percent with the market value of equity deflator. Also, Brown, Foster, and Noreen [1984] find that the use of the average absolute change in the series as a deflator produces the strongest relation between unexpected earnings and unexpected returns.

[19] Biddle and Lindahl [1982] also report that results on incremental information content were not sensitive to the use of a random walk versus a random walk with a drift for earnings.

The market model was used to define the expected return during an event period that includes the date when financial statement information first becomes publicly available. To assess when information became available for our sample firms, 10-K filing dates were collected for 1979 and 1980, and in no case was the filing date later than three months after the fiscal year end. However, there were cases of the annual report not being mailed until the fourth month after the fiscal year end. Therefore, to ensure that the market reaction to annual report information would be included in the measured abnormal return, we chose a 12-month event period that includes the four months after the fiscal year end.[20] Parameters of the model are estimated over a period that includes 60 months prior to the first month in the event period, and the parameters are re-estimated for each firm year. This process can be described in four steps:

a. *OLS* estimation of the market model parameters, α_i and β_i:

$$r_{it}=\alpha_i+\beta_i r_{mt}+e_{it}$$

where

r_{it} = return on equity of firm i during period t, where $t=-60, -1$,

r_{mt} = return on the value weighted market portfolio in period t, and

e_{it} = firm specific error term.

b. Estimation of the monthly unexpected returns, μ_{it}:

$$\mu_{it}=r_{it}-\hat{\alpha}_i-\hat{\beta}_i r_{mt}$$

where $t=0, 11$.

c. Standardization of the unexpected returns, $s(\mu_{it})$.

Before summing the unexpected returns, each month's unexpected return is standardized by the forecast error for the particular month following Patell [1976]. The standardization can be written as:

$$s(\mu_{it})=\frac{\mu_{it}}{\sqrt{v_i C_{it}}}$$

where

v_i = estimated variance of the residuals from (1) for firm i during the estimation period, and

$$C_{it}=1+1/60 +[(r_{mt}-r_m)^2] \Big/ \left[\sum_{s=-60}^{-1}(r_{ms}-r_m)^2\right],$$

and

r_{ms} = return on the value weighted market portfolio for period s, and

r_m = average value of r_{ms} during the 60-month estimation period.

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[20] Of course, error in specifying this window would also reduce the power of the tests of association between unexpected earnings and unexpected returns. Results reported in Tables 3 and 4 are consistent with a significant association between unexpected earnings and unexpected returns. These benchmark results suggest that our event window is not seriously misspecified.

This standardization adjusts the dependent variable for cross-sectional differences in the expected return's variance and thus removes a potential cause of heteroscedasticity.[21]

d. Summing the standardized unexpected returns, $CSUR_i$:

Once the monthly returns have been standardized, they are accumulated over the 12-month event period to form a cumulative standardized expected return for firm *i* in year *y*:

$$CSUR_{iy}=\sum_{t=0}^{11} s(\mu_{ity}),$$

where *y* ranges from 1972 through 1981.

Sample Selection

Calculation of working capital from operations requires information that cannot be obtained unless a firm uses the working capital format in the *SCFP*. Using only the data available from COMPUSTAT, it is not possible to unambiguously determine which of several alternative measures of net funds was used. Therefore, we started with the sample of 324 firms from Bowen et al. [1986] which consistently used the working capital format to minimize measurement error in the process of converting accruals to cash flows and to ensure that the conversion process was consistent across sample firms in every year.[22] To have the return data necessary to estimate *CSUR*s, monthly returns from the *CRSP* monthly return file for the years 1967–1982 were also required. This requirement left a final sample of 98 firms. Although these strict data requirements limit the sample size, the requirements ensure that the computations are consistent both across firms and across years.

Table 1 profiles the sample relative to the population of firms with data on the COMPUSTAT file for the years 1972–81. The median sample firm (a) is larger in both sales and assets than the median COMPUSTAT firm, (b) is more capital intensive, and (c) has larger quick and interest coverage ratios. The leverage and growth measures for the sample and the population are roughly comparable in that sample medians are larger in some years and population medians are larger in other years. Thus, our sample firms tend to be larger and more liquid than the typical firm on COMPUSTAT. Because of this, cash flow information might be expected to have relatively *less* incremental importance for sample firms.

III. ECONOMETRIC MODELS

To test the hypotheses developed in section I, we use a cross-sectional regression approach similar to that used by Biddle and Lindahl [1982]. The full model is of the form:

$$\begin{aligned}CSUR_{it}=&\beta_0+\beta_1 UE_{it}\\&+\beta_2 UWCFO_{it}+\beta_3 UCFO_{it}\\&+\beta_4 UCFAI_{it}+e_{it}\end{aligned}\tag{1}$$

where

$CSUR_{it}$ = unexpected return to common equity for firm *i* over event period *t*,

UE_{it} = unexpected earnings for firm *i* in time period *t*,

$UWCFO_{it}$ = unexpected working capital from operations for firm *i* in period *t*,

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[21] To maintain a consistent relation between the left- and right-hand-side variables of the regression equation, we also standardize the independent variables using the same scalar. Jain [1983] discusses the econometric problems associated with estimating the cross-sectional regression model in a in the absence of cross-sectionally constant variances.

[22] See Bowen et al. [1986, p. 717] for further discussion of the sample selection criteria.

TABLE 1

DESCRIPTIVE STATISTICS
QUARTILES FOR SAMPLE FIRMS AND THE POPULATION OF ALL FIRMS ON THE COMPUSTAT FILE FOR 1972–81

		Net Sales[1]			*Total Assets*[2]			*Leverage*[3]			*Asset Turn*[4]			*Growth*[5]			*Quick Ratio*[6]			*Interest Coverage*[7]		
Year	*Sample*	*25%*	*50%*	*75%*	*25%*	*50%*	*75%*	*25%*	*50%*	*75%*	*25%*	*50%*	*75%*	*25%*	*50%*	*75%*	*25%*	*50%*	*75%*	*25%*	*50%*	*75%*
1972	Sample	102.7	205.5	377.6	77.6	160.6	481.6	.057	.179	.274	1.21	1.93	2.55	.032	.081	.125	1.06	1.32	1.63	3.94	7.70	25.98
	Population	30.3	83.6	300.5	24.2	69.4	233.7	.079	.192	.293	1.38	2.51	4.62	.031	.100	.206	.84	1.18	1.60	3.11	6.27	13.70
1973	Sample	126.7	235.0	499.1	87.5	168.6	544.5	.076	.194	.261	1.42	2.06	2.73	.067	.104	.179	.95	1.23	1.45	4.54	8.99	18.53
	Population	36.9	98.0	352.8	27.2	76.5	262.7	.086	.192	.290	1.47	2.68	4.70	.060	.131	.228	.78	1.09	1.46	3.09	5.86	12.27
1974	Sample	140.4	260.5	589.4	98.5	186.6	585.3	.071	.165	.242	1.53	2.19	2.92	.074	.126	.211	.72	1.02	1.45	3.89	8.04	15.06
	Population	37.4	107.3	391.2	27.6	79.4	289.7	.091	.193	.291	1.60	2.81	4.83	.027	.108	.213	.74	1.00	1.36	2.37	4.70	10.14
1975	Sample	139.6	287.4	628.9	104.5	189.9	638.3	.093	.202	.253	1.32	2.11	2.84	−.011	.038	.108	.90	1.30	1.82	3.47	6.05	12.33
	Population	37.7	109.3	396.4	27.1	79.3	296.9	.096	.197	.290	1.45	2.69	4.57	−.036	.038	.131	.82	1.11	1.56	2.25	4.84	9.94
1976	Sample	163.7	284.9	711.3	119.3	209.8	509.6	.080	.196	.245	1.37	2.00	2.91	.026	.092	.145	1.04	1.37	1.71	4.68	7.61	13.65
	Population	43.5	125.3	461.0	30.2	86.1	320.1	.086	.186	.277	1.59	2.84	4.74	.023	.092	.173	.81	1.14	1.52	2.96	5.99	13.49
1977	Sample	185.8	335.7	698.1	139.2	245.4	766.9	.077	.186	.251	1.37	2.09	3.07	.043	.104	.145	1.04	1.35	1.85	4.27	8.33	17.87
	Population	50.2	146.3	539.8	35.3	96.7	353.2	.087	.187	.285	1.59	2.86	4.79	.038	.104	.197	.81	1.12	1.51	3.18	6.04	13.51
1978	Sample	204.0	364.0	801.1	158.7	247.3	765.8	.072	.170	.251	1.31	2.25	3.09	.072	.121	.181	.93	1.24	1.56	4.03	8.60	17.09
	Population	56.6	167.1	599.0	39.9	113.0	421.9	.093	.191	.293	1.62	2.86	4.74	.068	.139	.242	.81	1.09	1.50	3.03	5.54	11.87
1979	Sample	254.0	431.5	1013.2	189.0	303.7	923.1	.071	.167	.233	1.50	2.40	3.21	.083	.150	.234	.85	1.19	1.45	4.12	7.38	15.55
	Population	62.6	194.5	699.8	44.0	131.6	500.1	.087	.191	.292	1.70	2.93	4.79	.063	.139	.249	.78	1.06	1.42	2.73	5.17	10.39
1980	Sample	270.8	433.9	1155.4	203.2	341.4	1008.6	.075	.161	.242	1.50	2.12	2.95	.027	.097	.146	.83	1.13	1.52	3.10	5.82	13.68
	Population	60.9	208.5	722.0	45.3	140.6	538.7	.087	.189	.287	1.70	2.88	4.71	.025	.106	.213	.79	1.09	1.49	2.26	4.37	9.31
1981	Sample	282.7	476.7	1234.3	223.9	351.9	1077.4	.060	.144	.222	1.45	2.03	2.94	−.003	.068	.128	.76	1.12	1.46	3.03	5.14	15.70
	Population	66.1	221.9	780.2	49.6	153.2	576.5	.090	.187	.290	1.59	2.78	4.56	.019	.097	.209	.76	1.07	1.49	1.96	4.01	8.75

[1] COMPUSTAT item #12 in millions.

[2] COMPUSTAT item #6.

[3] Long-term debt (COMPUSTAT item #9) divided by total assets.

[4] Net sales divided by gross plant assets (COMPUSTAT item #7).

[5] (End of period total assets divided by beginning of period total assets)-1.0.

[6] Cash plus short-term marketable securities (COMPUSTAT items #1 and #2) divided by current liabilities (item #5).

[7] Income before extraordinary items plus interest expense plus income taxes plus minority interest (COMPUSTAT items #15+#16+#18+#49) divided by interest expense.

TABLE 2

PAIRWISE CORRELATIONS BETWEEN THE INDEPENDENT VARIABLES

	Correlation Between Unexpected Values of					
Year	E, WCFO	E, CFO	E, CFAI	WCFO, CFO	WCFO, CFAI	CFO, CFAI
1972	.678	−.004	−.065	.252	.082	.123
1973	.727	.127	−.007	.130	−.045	−.008
1974	.727	.595	−.207	.296	−.117	.044
1975	.076	−.004	−.098	−.004	−.746	.016
1976	.642	.012	.063	.011	.136	.199
1977	.436	.023	−.004	.029	−.018	−.005
1978	.814	−.031	−.021	−.105	−.039	.010
1979	.289	.245	.030	.163	.054	.083
1980	.231	.025	.003	−.037	−.009	.009
1981	.047	.136	−.071	−.022	.126	.136
1972–81	.051	.034	−.009	−.002	−.118	.009

$UCFO_{it}$ = unexpected cash flow from operations for firm i in time period t,
$UCFAI_{it}$ = unexpected cash flow after investment for firm i in time period t, and
e_{it} = error term for firm i in period t, assumed to be normal with a distribution $(0, s^2I)$.

Tests of the incremental information content of individual independent variables conditioned on the information provided by the remaining three variables could be formulated as tests of the statistical hypotheses $\beta_1=0$, $\beta_2=0$, $\beta_3=0$, and $\beta_4=0$, respectively. For example, a test of $\beta_1=0$ would be a test of the incremental information content of unexpected earnings in addition to that contained in unexpected values of *WCFO* and the two measures of cash flow. However, to the extent that the independent variables are correlated, it is difficult to untangle the relative influences of the various independent variables and explanatory power common to the independent variables is not assigned to *any* of the coefficients (see Christie et al. [1984]). Evidence reported in Patell and Kaplan [1977] and Bowen et al. [1986] suggests that certain combinations of independent variables in (1) are likely to be highly correlated, making interpretation of significance tests on individual coefficients difficult. Therefore, several of the tests discussed below are framed as tests of the joint significance of combinations of independent variables.

Cross-sectional correlations between the independent variables in (1) are presented in Table 2. The pair of accrual flows, *UE* and *UWCFO*, are highly correlated in most years. Consequently, we test the hypothesis that the coefficients on *UE* and *UWCFO* are both equal to zero. Although not highly correlated, the cash flow measures, *UCFO* and *UCFAI*, have similar definitions. Because we have little *a priori* basis for including just one variable from the pair in the model relating earnings and cash flows, we conduct *F*-tests of the hypothesis that the coefficients on *UCFO* and

UCFAI are both equal to zero. These tests of incremental information content are based on comparisons of the sum of the squared errors from model (1) and the following models.

$$CSUR_{it}=\beta_0+\beta_1 UE_{it}+e_{it} \qquad (2)$$

$$CSUR_{it}=\beta_0+\beta_1 UE_{it} +\beta_2 UWCFO_{it}+e_{it} \qquad (3)$$

$$CSUR_{it}=\beta_0+\beta_1 UE_{it} +\beta_3 UCFO_{it} +\beta_4 UCFAI_{it}+e_{it} \qquad (4)$$

$$CSUR_{it}=\beta_0+\beta_3 UCFO_{it} +\beta_4 UCFAI_{it}+e_{it} \qquad (5)$$

For example, a test of the incremental information content in both of the measures of cash flow relative to that contained in the reported accrual accounting numbers uses the sum of squared errors from (1) and (3). This is equivalent to testing whether the cash flow terms *jointly* add to the accrual data.[23]

Models (1) through (5) could be estimated in three ways: (1) pooled both cross-sectionally and intertemporally; (2) cross-sectionally by year; or (3) intertemporally by firm. Due to limitations on the number of years for which data were available to define the variables in model (1), we use only the first two estimation procedures.[24]

The first estimation procedure, pooling the data cross-sectionally and intertemporally, assumes that all firms have the same response to unexpected percentage changes in accrual and cash flow variables, and that the relations are stable across time. This procedure assumes that an unexpected negative cash flow is accompanied by the same unexpected security return (in both direction and magnitude) in a prosperous year as in a recession year. To decrease the probability that this assumption is violated, we transform the independent variables by subtracting the cross-sectional mean of each independent variable from the value of that observation in each year. For example, unexpected earnings (*UE*) in any given year is expressed as the deviation from the mean *UE* across all firms for that year. Thus, for a firm with a "slightly" negative *UE* in a year when most other firms had a "very" negative *UE*, the model would predict a higher unexpected return than for other firms. These transformed data are more likely to conform to the assumptions required for pooling data across years.

The second estimation procedure, cross-sectionally by year, does not require the assumption that the relations are stable across time. However, since there are substantially less data available to estimate the model for individual years, the coefficients in individual year regressions will be subject to much larger estimation errors. Further, the individual year regressions (as well as the pooled regressions) could be subject to serious errors in inference due to bias in the standard errors of the coefficients as discussed in Bernard [1986]. While Bernard's analysis suggests that cross-sectional correlation may not be a serious problem in our study,[25] we also present an alternative analysis in section

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[23] The testing procedure is discussed in more detail in section IV.

[24] Beaver, Griffin, and Landsman [1982, pp. 13-16] discuss the merits of the cross-sectional approach.

[25] Bernard [1986] suggests that systematic bias in the standard errors of the coefficients may be reduced when cross-sectional correlation decreases, sample size decreases, or the number of industries represented in the sample increases. Since 45 of 98 firms in the sample had non-December 31 fiscal year ends, for the individual year results, cross-sectional correlation should be reduced because the annual event windows do not overlap perfectly. Further, consistent with Bernard's empirical results, the effect of cross-sectional correlation should be reduced because our sample consists of 98 firms drawn from 31 two-digit SIC industries. Note that if cross-correlation does induce bias in standard errors, the effect could be just as serious in the pooled regressions as in the cross-sectional regressions.

IV using cross-temporal t-statistics that are not subject to downward-biased standard errors due to cross-sectional correlation in the market model regression residuals.

IV. RESULTS

In the first pair of subsections below, we discuss results from regressions pooled over the period 1972–81. In the next pair of subsections, year-by-year results and cross-temporal t-statistics are presented as a check on some of the assumptions underlying the pooled models. Within each pair of subsections, the results are discussed from two perspectives.

The first perspective takes as given the current institutional environment where historical cost accrual accounting is the focus of most financial reporting and analysis. From this "institutional" perspective, the primary issue is whether cash flow data add to the information provided by the accrual accounting system. However, we also reexamine whether *WCFO* has incremental information content in addition to that provided by earnings. Tests of these hypotheses are presented in the first and third subsections.

The second perspective adopts the view that cash flows are the more primitive concept. The variability and timing of future cash flows are attributes of concern to investors. From this perspective, we ask: Do accrual numbers add anything to cash flow information? Tests of this hypothesis are presented in the second and fourth subsections. These two perspectives are clearly not independent—they are merely "opposite sides of the same coin"—and only one of the two perspectives should be adopted.

Since coefficient estimates from a regression may be strongly influenced by extreme values of the independent variables, we construct a sample in which observations with an absolute percentage change of greater than 100 percent were arbitrarily replaced by 100 percent. We label this the "winsorized" sample. We discuss the results for this modified data set in footnotes throughout the following subsections.

Pooled Results on H_1— The "Institutional" Perspective

As discussed above, we label the perspective taken in this subsection as "institutional" because, in the existing corporate reporting environment, historical cost accrual earnings appear to be the dominant concern of accountants, analysts, and investors. In the subsections below, we first examine the relation between earnings and unexpected security returns as a benchmark. We then examine the potential of other variables (especially "cash flows") to provide incremental information beyond that contained in earnings flows.

Information Content of Earnings. Prior research has established a clear association between unexpected security returns and unexpected earnings. We reexamine this link with a different sample using a different method than most prior studies to provide a benchmark for evaluating the remainder of our results. We test for an association between unexpected earnings and security returns in model (2): $CSUR_{it} = \beta_0 + \beta_1 UE_{it} + e_{it}$. As expected, the results reported in Table 3 for model (2) show a significant association between earnings and unexpected returns with a t-statistic for the coefficient on *UE* of 4.08.[26]

Incremental Information Content of WCFO *Beyond Earnings.* Patell and Kaplan [1977] found no evidence of incremental information content of per-

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[26] For the winsorized sample, the t-statistic on *UE* was 10.79. Details of the winsorized results are available from the authors.

TABLE 3

ASSOCIATION BETWEEN UNEXPECTED RETURNS AND UNEXPECTED ACCRUAL AND CASH FLOW DATA
SUMMARY OF POOLED REGRESSION RESULTS, 1972–81

	Estimated Coefficients (t-*statistics*)						*F-ratios for* H_0:	
Model #[a]	UE	UWCFO	UCFO	UCFAI	R^2	F-*ratio*	$\beta_3=\beta_4=0$	$\beta_1=\beta_2=0$
(2)	.016 (4.08)***				.02	16.62***	NA	NA
(3)	.015 (4.04)***	.002 (0.43)			.02	8.39***	NA	NA
(4)	.018 (4.66)***		.003 (3.58)***	.001 (2.81)***	.04	12.58***	10.42***	NA
(1)	.018 (4.62)***	.002 (0.63)	.003 (3.58)***	.001 (2.84)***	.04	9.53***	11.04***	10.56***
(5)			.003 (3.63)***	.001 (1.59)*	.02	7.87***	NA	NA

where:

MODEL (1): $CSUR_{it}=\beta_0+\beta_1 UE_{it}+\beta_2 UWCFO_{it}+\beta_3 UCFO_{it}+\beta_4 UCFAI_{it}+e_{it}$

MODEL (2): $CSUR_{it}=\beta_0+\beta_1 UE_{it}+e_{it}$

MODEL (3): $CSUR_{it}=\beta_0+\beta_1 UE_{it}+\beta_2 UWCFO_{it}+e_{it}$

MODEL (4): $CSUR_{it}=\beta_0+\beta_1 UE_{it}+ \qquad +\beta_3 UCFO_{it}+\beta_4 UCFAI_{it}+e_{it}$

MODEL (5): $CSUR_{it}=\beta_0+ \qquad +\beta_3 UCFO_{it}+\beta_4 UCFAI_{it}+e_{it}$

[a] Listed in order of discussion in text.
* Significant at the .10 level.
** Significant at the .05 level.
*** Significant at the .01 level.

centage changes in *WCFO*. We reexamine the incremental information content of *WCFO* for a different sample of firms over a longer time period because working capital continues to be a common definition of funds. Table 3 contains the pooled results from regression model (3): $CSUR_{it}=\beta_0+\beta_1 UE_{it}+\beta_2 UWCFO_{it}+e_{it}$. The coefficient on *UWCFO* is not significant.[27] Thus, there is no evidence that *WCFO* has incremental explanatory power beyond that contained in earnings.

Incremental Information Content of Cash Flows Beyond Earnings. The second column from the right in Table 3 under model (4) presents *F*-tests for the null hypothesis that both coefficients on the cash flow variables (β_3 and β_4) are zero. The *F*-ratio of 10.42 is significant at conventional levels. Coefficients on the individual cash flow variables (*UCFO* and *UCFAI*) are also significant. These results are consistent with the alternative hypothesis that unexpected cash flows provide information beyond that contained in unexpected earnings.[28]

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[27] Similar results obtain for the winsorized sample.

[28] Results differ somewhat for the winsorized sample. The cash flow variables remain jointly significant and the coefficient on *UCFO* is individually significant at the .05 level with a *t*-statistic of 1.69. However, the coefficient on *UCFAI* is not individually significant—per-haps because winsorizing converted the vast majority of the *CFAI* observations to ±100 percent, thus removing much of its variability

Incremental Information Content of Cash Flows Beyond Accruals. By comparing models (1) and (3) as discussed in section III, we can test the null hypothesis that the coefficients on the cash flow variables are both equal to zero when *UE* and *UWCFO* are included in the model. The second column from the right in Table 3 under model (1) presents the *F*-test for this hypothesis. The *F*-ratio of 11.04 is again significant at conventional levels. Coefficients on the individual cash flow variables *UCFO* and *UCFAI* are also again significant. These results are consistent with the alternative hypothesis that unexpected cash flows (*UCFO* and *UCFAI*) provide information beyond that contained in unexpected accrual flows (*UE* and *UWCFO*).[29]

Pooled Results on H_2—The Perspective that Cash Flows are the Primitive Concept

In the discussion below, we initially examine the relation between cash flows and security returns. Next, we test for incremental information content provided by earnings *and WCFO* beyond the information contained in cash flows. Again note that the results presented in Table 3 and discussed below are *not* independent of those presented in the above subsection.

Information Content of Cash Flows. Based on the *F*-ratio of 7.87 for model (5) in Table 3, the pair of coefficients on *UCFO* and *UCFAI* are jointly significant at conventional levels. This result suggests that *CFO* and *CFAI* jointly possess information content. Also, the coefficients on *UCFO* and *UCFAI* were individually significant in the pooled regression at conventional levels.[30]

Incremental Information Content of Earnings Beyond Cash Flows. In model (4) in Table 3, unexpected earnings is added to the cash flow variables previously discussed. We test the null hypothesis, $\beta_1=0$, by examining the *t*-statistic on β_1. With a *t*-statistic of 4.66, we reject the null that the coefficient on earnings (β_1) equals zero at conventional levels. This result suggests that unexpected earnings provide information beyond that contained in unexpected cash flows.[31]

Incremental Information Content of Earnings and WCFO Beyond Cash Flows. Finally, we address the question of whether the operating flow variables traditionally presented in financial statements (earnings and *WCFO*) add to the information provided by measures of cash flow. The *F*-ratio of 10.56 comparing models (1) and (5) (reported in the right-hand column of Table 3) indicates that the coefficients on *UE* and *UWCFO* are jointly significant at conventional levels. Although this result is consistent with the alternative hypothesis that accrual operating flows (earnings and *WCFO*) jointly possess information in addition to that contained in cash flow variables (*CFO* and *CFAI*), the small *t*-statistic on *UWCFO* suggests that earnings provides most of the incremental explanatory power.[32]

Year-by-Year Results for H_1—The "Institutional" Perspective

Year-by-year results are presented as a check on violation of the stationarity assumptions underlying the pooled models and to provide a test of incremental information content not subject to bias due to cross-sectional correlation in the residuals of the market model regressions. The estimated coefficients will vary from year to year due to (1) changes in underlying structure of the model (if any), and (2) estimation error. Although we cannot determine which of these factors explains observed cross-temporal variation in the coefficient estimates, markedly unstable signs and magnitudes on the coefficients would lower our confidence in the pooled results discussed above.

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[29] For the winsorized sample, the cash flow variables are jointly significant and the coefficient on *UCFO* is individually significant (at the .05 level with a *t*-statistic of 1.65), while the coefficient on *UCFAI* is not individually significant.

[30] For the winsorized sample, the cash flow variables remain jointly significant and *UCFO* is individually significant at the .01 level with a *t*-statistic of 3.32. However, *UCFAI* is not individually significant.

[31] A *t*-statistic of 10.39 was obtained for the winsorized sample.

[32] Similar results obtain for the winsorized sample.

The individual yearly estimates of the coefficients can also be used to form an overall assessment of the significance of the relation between unexpected returns and unexpected cash and accrual flows. At the bottom of Tables 4 through 8, *t*-statistics calculated using the cross-temporal mean and standard deviation of the ten yearly coefficient estimates are presented. If the stationarity assumptions underlying the pooled models are met, the cross-temporal *t*-statistics would provide another valid test of the hypothesis that the coefficient is zero. However, even if the stationarity assumptions are not met so that the results in Table 3 are not reliable, the cross-temporal *t*-statistics can still be interpreted as tests of a different hypothesis, i.e., the hypothesis that the *average* coefficient is equal to zero.

Results for benchmark model (2) are presented in Table 4. The sign on *UE* is positive in every year and significant at the .10 level or better in six of ten years. The average coefficient on *UE* is .081 with a cross-temporal *t*-statistic of 2.02. Thus, as with the pooled model, individual year results are consistent with the conclusion that there is a significant association between unexpected earnings and unexpected returns.[33]

Results for model (3) are presented in Table 5. The coefficients on *UWCFO* in Table 5 are negative in four years and only two of the six positive coefficients are significant at the .10 level or better. The average coefficient on *UWCFO* is .036 with a cross-temporal *t*-statistic of 0.70. Thus, consistent with the pooled results, there is little evidence that *WCFO* provides incremental information beyond earnings.[34]

Tables 6 and 7 present year-by-year results on the association between unexpected cash flows and unexpected security returns in the presence of earnings alone (in Table 6) and earnings and *WCFO* (in Table 7). In each of Tables 6 and 7, there are two (three) individual years for which the relation between unexpected returns and *UCFO* (*UCFAI*) is significant. In Table 6, the average coefficient on *UCFO* (*UCFAI*) is .013 (.001) with a cross-temporal *t*-statistic of 1.43 (0.69), while in Table 7, the average coefficient on *UCFO* (*UCFAI*) is .015 (.001) with a cross-temporal *t*-statistic of 1.81 (0.71). Thus, as with the pooled results, the cross-temporal *t*-statistics derived from the individual year models suggest that *CFO* provides incremental information beyond that provided by accrual flows.[35]

In summary, cash flow measures (primarily *CFO*) have significant incremental information above that contained in earnings (and *WCFO*) in at least some

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[33] For the winsorized sample, the coefficient on *UE* is significant in every year and the cross-temporal *t*-statistic is 6.39.

[34] Similar results obtain for the winsorized sample.

[35] For the winsorized sample, the coefficients on *UCFO* are significant in four (five) years for Table 6 (Table 7) while the coefficients on *UCFAI* are never significant. Also, the cross-temporal *t*-statistics for the coefficients on *UCFO* are 3.06 (for model 4) and 2.53 (for model 1) while the cross-temporal *t*-statistics for *UCFAI* are not significant. Thus, the winsorized results more strongly support the hypothesis that *CFO* (but not *CFAI*) has incremental information content.

TABLE 4

ASSOCIATION BETWEEN UNEXPECTED RETURNS AND UNEXPECTED EARNINGS

MODEL (2): $CSUR_{it}=\beta_0+\beta_1 UE_{it}+e_{it}$

	Estimated Coefficient (t-*statistic*)			
Year	*Intercept*	UE	R^2	F-*ratio*
1972	−.420 (−3.81)***	.094 (3.74)***	.13	13.95***
1973	.091 (0.73)	.432 (5.63)***	.25	31.73***
1974	.135 (1.12)	.001 (0.11)	.01	0.01
1975	−.085 (−0.72)	.028 (1.22)	.02	1.50
1976	−.032 (−0.37)	.058 (1.21)	.02	1.47
1977	−.036 (−0.42)	.063 (3.42)***	.11	11.67***
1978	−.070 (−0.78)	.058 (1.99)**	.04	3.96**
1979	.073 (0.69)	.018 (2.91)***	.08	8.48***
1980	.067 (0.55)	.012 (0.48)	.01	0.23
1981	−.136 (−1.12)	.044 (1.94)**	.04	3.78**
Mean† *t*-statistic	−.041 (−0.82)	.081 (2.02)**		

† Values in this row are the means of the ten yearly coefficients above. Significance levels are for one-tailed cross-temporal *t*-tests with nine degrees of freedom—except for the intercept which uses a two-tailed test.

* Significant at the .10 level.

** Significant at the .05 level.

*** Significant at the .01 level.

years. Results of *t*-tests for individual years are generally weaker than the pooled results in Table 3, which is expected given the smaller sample size available for individual years. However, the cross-temporal *t*-tests consistently support the hypothesis of incremental information for *CFO*. Finally, cross-temporal *t*-tests are generally consistent with *t*-tests from the pooled model, suggesting that results from the pooled model are not invalidated by violations of the assumptions of stationarity and independence.

Year-by-Year Results for H_2— The Perspective that Cash Flows are the Primitive Concept

In Table 8, the estimated coefficients on *UCFO* (*UCFAI*) are positive in seven (eight) of ten years and significant in three (one) of ten years. In the two years where the coefficients are jointly significant (1972 and 1975), unexpected

TABLE 5
ASSOCIATION BETWEEN UNEXPECTED RETURNS AND UNEXPECTED ACCRUAL FLOWS
MODEL (3): $CSUR_{it}=\beta_0+\beta_1 UE_{it}+\beta_2 UWCFO_{it}+e_{it}$

	Estimated Coefficient (t-statistic)				
Year	*Intercept*	UE	UWCFO	R^2	F-*ratio*
1972	−.517 (−4.66)***	.009 (0.23)	.389 (2.96)***	.20	11.92***
1973	.132 (0.98)	.508 (4.29)***	−.190 (−0.84)	.25	16.17***
1974	.122 (1.06)	−.001 (−0.16)	.040 (0.69)	.01	0.24
1975	−.091 (−0.76)	.028 (1.25)	−.002 (−0.53)	.02	0.88
1976	−.011 (−0.12)	.094 (1.26)	−.093 (−0.63)	.02	0.93
1977	−.040 (−0.47)	.053 (2.66)***	.044 (1.25)	.12	6.65***
1978	−.030 (−0.28)	.081 (1.73)**	−.105 (−0.63)	.04	2.17
1979	−.015 (−0.14)	.013 (2.03)**	.207 (2.92)***	.16	8.83***
1980	.066 (0.54)	.006 (0.23)	.031 (1.28)	.02	0.93
1981	−.143 (−1.17)	.043 (1.89)**	.043 (0.66)	.04	2.10
Mean† *t*-statistic	−.053 (−0.90)	.083 (1.73)*	.036 (0.70)		

† Values in this row are the means of the ten yearly coefficients above. Significance levels are for one-tailed cross-temporal *t*-tests with nine degrees of freedom—except for the intercept which uses a two-tailed test.

* Significant at the .10 level.

** Significant at the .05 level.

*** Significant at the .01 level.

cash flows explained 13 and 15 percent, respectively, of the variation in unexpected returns across firms. Also, the cross-temporal *t*-statistic for the coefficient on *UCFO* is 1.58, which is significant at the .10 level.[36]

Table 6 presents the year-by-year results on the association between unexpected earnings and unexpected security returns in the presence of the cash flow variables. In nine of ten years, the coefficient on *UE* is significant at conventional levels. The average coefficient on *UE* is .086 with a cross-temporal *t*-statistic of 2.23.[37] Table 7 presents results on the accrual variables *UE* and *UWCFO* in the presence of the cash flow variables. In seven (two) of ten years, the

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[36] For the winsorized sample, coefficients on *UCFO* (*UCFAI*) are significant in eight (zero) of ten years. Also, the cross-temporal *t*-statistic for the coefficient on *UCFO* is 4.46 while the corresponding *t*-statistic for *UCFAI* is not significant.

[37] The cross-temporal *t*-statistic is 6.58 for the winsorized sample.

TABLE 6

ASSOCIATION BETWEEN UNEXPECTED RETURNS AND UNEXPECTED EARNINGS AND CASH FLOW DATA

MODEL (4): $CSUR_{it}=\beta_0+\beta_1 UE_{it}+\beta_3 UCFO_{it}+\beta_4 UCFAI_{it}+e_{it}$

	Estimated Coefficients (t-statistics)						F-ratio: H_0:
Year	*Intercept*	UE	UCFO	UCFAI	R^2	F-*ratio*	$\beta_3=\beta_4=0$
1972	−.298	.088	.095	.001	.23	9.26***	6.18***
	(−2.70)***	(3.68)***	(3.33)***	(0.93)			
1973	.125	.426	.004	.001	.26	10.68***	0.39
	(0.95)	(5.47)***	(0.66)	(0.60)			
1974	.143	.065	.001	.010	.03	1.08	1.62
	(1.19)	(1.77)**	(0.29)	(1.78)**			
1975	−.029	.027	.004	−.001	.16	5.99***	7.24***
	(−0.26)	(1.29)*	(4.02)***	(−0.33)			
1976	−.074	.063	−.003	−.009	.05	1.48	1.48
	(−0.84)	(1.32)*	(−0.38)	(−1.56)			
1977	−.003	.062	.005	.001	.13	4.70**	1.20
	(−0.04)	(3.41)***	(1.21)	(0.97)			
1978	−.086	.059	−.003	.002	.07	2.32	1.48
	(−0.94)	(2.04)**	(−0.89)	(1.48)*			
1979	.092	.016	.023	.003	.11	3.76**	1.39
	(0.82)	(2.59)***	(0.94)	(1.29)*			
1980	.070	.011	−.002	.001	.01	0.22	0.23
	(0.56)	(0.48)	(−0.35)	(0.58)			
1981	−.154	.042	.010	.001	.04	1.44	0.29
	(−1.22)	(1.82)**	(0.69)	(0.17)			
Mean†	−.021	.086	.013	.001			
t-statistic	(−0.49)	(2.23)**	(1.43)*	(0.69)			

† Values in this row are the means of the ten yearly coefficients above. Significance levels are for one-tailed cross-temporal *t*-tests with nine degrees of freedom—except for the intercept which uses a two-tailed test.
* Significant at the .10 level.
** Significant at the .05 level.
*** Significant at the .01 level.

relation between unexpected returns and *UE* (*UWCFO*) is individually significant at conventional levels. The average coefficient on *UE* (*UWCFO*) is .092 (.018) with a cross-temporal *t*-statistic of 1.98 (0.40).[38] Thus, as with the pooled results, the cross-temporal *t*-statistics derived from the individual year models suggest that earnings but not *WCFO* provide incremental information beyond that provided by cash flows alone.

In summary, the cash flow variables (primarily *CFO*) have significant information content by themselves. The accrual-based variables (primarily earnings) frequently have significant incremental information beyond that contained in cash flow numbers. The cross-temporal

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[38] For the winsorized sample, the cross-temporal *t*-statistics for the coefficients on *UCFO* and *UCFAI* are 5.12 and −.05, respectively.

TABLE 7
ASSOCIATION BETWEEN UNEXPECTED RETURNS AND UNEXPECTED ACCRUAL AND CASH FLOW DATA
MODEL (1): $CSUR_{it}=\beta_0+\beta_1 UE_{it}+\beta_2 UWCFO_{it}+\beta_3 UCFO_{it}+\beta_4 UCFAI_{it}+e_{it}$

	Estimated Coefficients (t-*statistics*)							F-*ratios for* H_o:	
Year	*Intercept*	UE	UWCFO	UCFO	UCFAI	R^2	F-*ratio*	$\beta_3=\beta_4=0$	$\beta_1=\beta_2=0$
1972	−.389	.028	.281	.077	.001	.26	8.32***	3.98	9.23***
	(−3.34)***	(0.75)	(2.11)**	(2.63)***	(0.89)				
1973	.167	.502	−.190	.04	.001	.26	8.18***	0.39	15.24***
	(1.18)	(4.20)***	(−0.84)	(0.71)	(0.53)				
1974	.149	.080	−.038	−.001	.012	.04	0.84	1.43	1.62
	(1.22)	(1.37)*	(−0.34)	(−0.08)	(1.43)*				
1975	−.036	.027	−.004	.004	−.002	.17	4.66**	8.30***	1.19
	(−0.32)	(1.30)*	(−0.84)	(4.02)***	(−0.73)				
1976	−.060	.085	−.058	−.003	−.008	.05	1.15	0.94	1.35
	(−0.62)	(1.14)	(−0.39)	(−0.39)	(−1.47)				
1977	−.007	.053	.043	.005	.001	.14	3.92**	1.17	6.58***
	(−0.09)	(2.66)***	(1.22)	(1.18)	(0.99)				
1978	−.038	.088	−.130	−.002	.001	.08	1.88	1.57	2.39
	(−0.34)	(1.88)**	(−0.78)	(−0.97)	(1.50)*				
1979	.000	.012	.201	.018	.003	.18	5.05***	1.24	7.64***
	(0.00)	(1.82)**	(2.84)***	(0.77)	(1.30)*				
1980	.069	.006	.031	−.002	.001	.02	0.57	0.22	0.91
	(0.55)	(0.23)	(1.26)	(−0.32)	(0.59)				
1981	−.157	.041	.040	.010	.001	.05	1.16	0.25	1.82
	(−1.23)	(1.77)**	(0.60)	(0.69)	(0.03)				
Mean†	−.030	.092	.018	.015	.001				
t-statistic	(−0.60)	(1.98)**	(0.40)	(1.81)*	(0.71)				

† Values in this row are the means of the ten yearly coefficients above. Significance levels are for one-tailed cross-temporal *t*-tests with nine degrees of freedom—except for the intercept which uses a two-tailed test.

* Significant at the .10 level.

** Significant at the .05 level.

*** Significant at the .01 level.

t-tests support the hypothesis of incremental information content of earnings and are generally consistent with the *t*-tests from the pooled model.

An Alternative Approach to Extreme Observations

As an additional assessment of the influence of extreme observations on the results, we constructed a sample in which the nine observations with the greatest absolute deviation from the mean for each independent variable for each year were arbitrarily dropped from the sample. This procedure could have eliminated up to 36 observations for each year—nine for each independent variable times four independent variables. However, since *UE* and *UWCFO* tend to be highly correlated, an unusual observation for *UE* was also typically unusual for *UWCFO* (but was seldom unusual for *UCFO* or *UCFAI*). Consequently, the final "reduced" sample totaled 722,

TABLE 8

ASSOCIATION BETWEEN UNEXPECTED CASH FLOW DATA AND UNEXPECTED RETURNS
MODEL (5): $CSUR_{it}=\beta_0+\beta_3 UCFO_{it}+\beta_4 UCFAI_{it}+e_{it}$

	Estimated Coefficients (t-statistics)				
Year	*Intercept*	UCFO	UCFAI	R²	F-*ratio*
1972	−.263 (−2.25)**	.103 (3.41)***	.001 (0.80)	.13	6.31***
1973	.476 (3.63)***	.008 (1.25)	.001 (0.41)	.02	0.86
1974	.140 (1.15)	.001 (0.28)	.001 (0.19)	.01	0.01
1975	−.060 (−0.55)	.004 (4.01)***	−.001 (−0.46)	.15	8.10***
1976	−.053 (−0.60)	−.003 (−0.41)	−.008 (−1.47)	.03	1.35
1977	−.012 (−0.13)	.005 (1.20)	.001 (0.91)	.02	1.13
1978	−.072 (−0.78)	−.003 (−0.94)	.002 (1.36)*	.03	1.34
1979	.093 (0.80)	.036 (1.53)*	.003 (1.27)	.04	2.16
1980	.072 (0.58)	−.002 (−0.34)	.001 (0.59)	.01	0.23
1981	−.183 (−1.44)	.014 (0.92)	.001 (0.18)	.01	0.49
Mean† *t*-statistic	.014 (0.21)	.016 (1.58)*	.000 (0.21)		

† Values in this row are the means of the ten yearly coefficients above. Significance levels are for one-tailed cross-temporal *t*-tests with nine degrees of freedom—except for the intercept which uses a two-tailed test.

* Significant at the .10 level.

** Significant at the .05 level.

*** Significant at the .01 level.

representing approximately a 25 percent overall reduction in the pooled sample size, with sample sizes in individual years ranging from 69 in 1977 to 75 in 1974.

Results for this reduced sample generally provide similar evidence of the information content of earnings and weaker evidence of the incremental information content of cash flows.[39] In the pooled results, in no case were the cash flow variables individually or jointly significant in the presence of either earnings alone or earnings and *WCFO*. In individual year-by-year tests parallel to those in Tables 6 and 7, in three individual years, *UCFO* had significant incremental explanatory power at conventional levels. However, cross-temporal *t*-statistics were insignificant for both *UCFO* and *UCFAI*.

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[39] In tests parallel to those in Table 8, the coefficient on *UCFO* was significant in five of ten years with a cross-temporal *t*-statistic of 2.47. However, in no year was *UCFAI* individually significant—either alone or in tests of incremental explanatory power beyond that contained in accrual variables *UE* and *UWCFO*

The result that cash flows do not provide significant incremental information in this reduced sample is subject to at least four interpretations. The first is that the extreme observations that were dropped were the cause of a statistical artifact in the original sample. However, the generally significant results for the winsorized sample (in which the extreme observations are retained but receive substantially less weight) are not consistent with this interpretation. A second interpretation is that the underlying unexpected cash flow variables have more noise than do the relatively more well-specified unexpected earnings and *WCFO* variables. Evidence in Bowen et al. [1986] is consistent with this speculation. A third possibility is that market participants are most interested in the extreme observations for cash flow variables. For example, if operating cash flows are an important signal about liquidity, extreme realizations of *CFO* may be the most important signals. Similarly, unusual observations of *CFAI* may possess incremental information if they reflect important unexpected investment or disinvestment activity. In either of the latter two cases, dropping the most extreme observations eliminates those that are likely to be accompanied by the largest unexpected security return—thus reducing the significance of the results. Finally, the reduction in the number of observations may account for at least some of the loss of significance.

V. SUMMARY

This study presents evidence on the incremental information content of cash and accrual flows from two alternative but not independent perspectives. Since the current financial reporting environment emphasizes accruals, the first perspective examines the incremental information content of cash flows after conditioning on accruals. Results are consistent with significant incremental information content for cash flow variables (particularly cash flow from operations) after controlling for the association between security returns and earnings. Results also indicate that cash flow data have incremental information content conditional on both earnings and working capital from operations. However, there is little evidence that *WCFO* has incremental information content relative to that contained in earnings. Thus, the results of this study suggest that cash flow information is consistent with the information impounded in security prices and also has incremental explanatory power beyond that contained in accrual flows alone.

Models of firm value in financial economics emphasize cash flows, and the second perspective examines whether modifications introduced by the accrual accounting process add to the underlying cash flow information. Results are consistent with significant incremental information content for earnings after controlling for the association between security returns and cash flows. In every form of the analysis, the results suggest that earnings has incremental explanatory power beyond the cash flow variables considered here. These findings suggest that accrual accounting data have incremental explanatory power beyond that contained in cash flows alone.

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NOTES

Historical Analysis—A Diagnostic Tool for "Events" Studies: The Impact of the Securities Act of 1933

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ABSTRACT: The primary objective of this study is to illustrate why an adequate historical inquiry should be considered an integral part of all "events" studies. We examine a recent events study that attempted to test the impact of the Securities Act of 1933. Our examination of the historical record results in three major criticisms of the author's research design: (1) lack of a control group, (2) an unsubstantiated test period, and (3) apparent misclassification of events (favorable/unfavorable/control) during the test period. We believe that these problems invalidate the conclusion that the Securities Act of 1933 had an adverse impact on stockholders' wealth.

EVENTS studies have had a prominent place in the accounting literature in recent years. These studies usually are designed to test the impact of an historical phenomenon, such as passage of a specific accounting standard or regulation. Historical analysis is a fundamental tool of archival research, yet accounting events studies rarely contain an analysis that is adequate to ensure the construct validity of the research design. Specification of an appropriate time frame, selection of critical events, and classification of events require judgments; historical analysis provides a mechanism for ensuring that those judgments are made on an informed basis.[1]

The basic objectives of this paper are to demonstrate how historical inquiry can be used to design an events study and to explain why such an analysis should be considered an integral part of all

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[1] See Brown and Vasarhelyi [1985] for a list of recent events studies in accounting. See Berlin [1966] and Porter [1981] for discussion of how value judgments affect selection and interpretation of data and the time frame of a study.

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accounting events studies. To highlight the importance of historical analysis, we examine a recent article, "The Inputs of Accounting Regulations of Bondholder and Shareholder Wealth: The Case of the Securities Acts" by Chee Chow [1983], recipient of the 1982 AAA manuscript award. Since Chow found no significant results with respect to the Securities and Exchange Act of 1934, we limit our analysis to assessment of the evidence used to support the research design for the Securities Act of 1933. We address three critical issues in all "events" studies—sample selection, specification of the time period for the study, and classification of events—to show the importance of basing the research design on an adequate historical inquiry.

Passage of the Securities Act of 1933 ('33 Act) was part of a temporal process in which indeterminate antecedent conditions culminated in a specific set of relations. A comprehensive historical inquiry would start with a chronological analysis of the antecedent conditions to provide insight into the process that culminated in the passage of the '33 Act. This sequential analysis serves as a heuristic, highlighting continuity and change, that enables the researcher to analyze the constituent elements of an event and to determine its significance by analysis of its impact on subsequent events [Porter, 1981]. Thus, to fully assess the impact of the '33 Act, we would have to examine its implementation as well as passage of the legislation. While such an analysis is beyond the scope of this note, future researchers may wish to examine the '33 Act in a broader context to assess the impact of the legislation.

Our inquiry follows the traditional documentary model of historical analysis [LaCapra, 1986]. We examine the historical record to evaluate the objectivity and comprehensiveness of Chow's sources, and to assess the construct validity of his research design. If posited relations do not isomorphically map to actual events, then a theory lacks *ex ante* descriptive power and the results of empirical tests become less meaningful.[2] We begin with an overview of the Chow study and an examination of the provisions of the '33 Act to show why those provisions appear inconsistent with the author's hypotheses and sample selection.

OVERVIEW OF THE CHOW STUDY

Chow [1983, p. 485] writes that his objective is to investigate how "the 1933 and 1934 Securities Acts affected investors' wealth." He uses an agency theory framework to develop a series of nine hypotheses related to possible redistributional impacts that regulation might have had on bondholders' and stockholders' wealth. Then, he tests these hypotheses by performing empirical tests of daily stock and bond returns on various dates classified as favorable/unfavorable/control. Chow hypothesizes that these events create positive excess returns to certain security holders and negative excess returns to others. By comparing the returns to stockholders and bondholders of a treatment group *versus* returns to stockholders and bondholders of a control group, he attempts to determine the impact of an event (on a particular date) on the treatment group. The treatment group consists of 196 New York Stock Exchange (NYSE) firms while the control group consists of 26 Over the Counter (OTC) firms traded publicly. All firms with new public issues between the '33 and '34 Acts are excluded from the sample.[3]

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[2] See Kaplan [1964], Pratt [1978], Handlin [1979], Hansen [1979], and Bailyn [1982] for discussion of the importance of a rigorous historical examination to ensure that posited relationships reasonably reflect the relationships existing in a particular time period. See LaCapra [1986] for an outline of the documentary model.

Chow measures wealth transfers by using portfolio comparisons with cross-sectional regression and correlation tests. He found no significant wealth transfers associated with the '34 Act; however, his tests of the '33 Act indicate that this regulation significantly reduced the returns to stockholders of exchange-listed companies. Test results with respect to bondholders were inconclusive for the '33 Act [Chow, 1983].

Eight of the nine hypotheses he generates are based on agency contracting costs. Chow [1983] posits that securities regulation might have had two adverse effects on shareholders' wealth by increasing compliance costs and reducing stockholders' flexibility to satisfy debt covenants through accounting means (restrictive hypothesis). He also posits that regulation may have benefited stockholders and bondholders by reducing contracting costs.[4] His rationale is that securities regulation would result in some degree of uniformity in financial disclosure, thereby eliminating the competitive disadvantage of those companies that had voluntarily disclosed information which may have deterred use of accounting-based debt covenants prior to regulation [Chow, 1983]. Thus, he concludes that the net effect on stockholders is indeterminate while the effect on bondholders is positive; i.e., an increase in wealth due to their ability to modify existing debt covenants and reduce contracting costs.[5]

These hypotheses are, in effect, causal propositions; they are used to explain the results of the subsequent empirical tests. From a historical perspective, these hypotheses must be viewed as tentative generalizations to be corroborated by an examination of the actual relations created by a particular event [Potter, 1973; Mandelbaum, 1977]. If the actual relations created by the '33 Act are not consistent with the relations posited by contracting cost theory, then the theory cannot generate valid explanation of the impact of that regulation.[6] Chow [1983, p. 507] interprets his stock return evidence to show that "at least part of the '33 Act's effects was transmitted through accounting-based debt covenants" and that the benefit of reduced contracting costs "was small relative to the costs of the new accounting provisions." From a historical perspective, Chow's interpretations appear tenuous.

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[3] Chow [1983] eliminates all companies with new issues (the only companies that would incur compliance costs) from his sample. He does so to avoid a confounding effect, arguing that if firms chose to incur increased compliance costs, they must have made the decision that benefits exceeded costs. Inclusion of such companies, he suggests, could mask the effects of the '33 Act.

[4] Chow [1983] also posits a third possible adverse impact—abridgment of the firm's permissible financing, investment, and production alternatives—along with the benefit associated with reduced contracting costs. The abridgment argument relates directly to the restrictive hypothesis, while the benefit argument does so in part; i.e., competitive disadvantage would decrease, increasing use of debt covenants. The other posited benefit was increased uniformity. To examine these assumptions, we would have to examine the implementation of the legislation, which is beyond the scope of this inquiry.

[5] Space constraints prohibit examination of the rationale for each of Chow's hypotheses. His last seven hypotheses are summarized below. He hypothesizes that increases in a firm's bondholders' wealth would vary directly with firm leverage and the number of different accounting indices in a firm's debt covenants and inversely with the firm's distance from its debt covenant provisions. He hypothesizes that stockholders' wealth will be proportional to the firm's leverage and number of accounting indices and a reduction in wealth inversely related to the firm's distance from its debt covenants. His last hypothesis, not related to agency contracting costs—i.e., size—is that larger firms would experience a proportionally smaller decrease in wealth than smaller firms [Chow, 1983, pp. 489-91].

[6] Berlin [1966, p. 16] points out the dangers of being "doctrinaire," i.e., "addicted to theory." Theoretical assumptions must be examined and shown to be reasonable with respect to the particular event being examined.

Since the '33 Act affected only companies with new issues and Chow eliminates all companies with new issues from his study, it seems questionable to attribute any adverse impact to increased compliance costs. The reasonableness of the restrictive hypothesis also is open to debate when applied to the '33 Act. The key question is: "Why should a disclosure regulation, limited to new issues, be posited to restrict stockholders' flexibility in satisfying debt covenants through accounting means?" Accounting variables used in debt covenants were based on annual reports; the '33 Act had no impact on annual reports.[7] An examination of the provisions of the '33 Act would appear to be the appropriate starting point for analysis of the research design in the Chow study.

THE PROVISIONS OF THE SECURITIES ACT OF 1933

The stated objectives of the '33 Act were to provide "full and fair disclosure of the character of securities sold in interstate and foreign commerce and through the mails, and to prevent frauds in the sale thereof, and for other purposes."[8] The most significant provisions of the '33 Act can be categorized as (1) registration provisions or (2) antifraud provisions. Section 5 prohibits transactions in unregistered securities via interstate or foreign commerce or via the mails. Sections 6 through 10 set forth the mechanics for registration of securities. Section 3 exempts certain securities such as short-term commercial paper, U.S. Treasury securities, municipal securities, securities of nonprofit corporations, and securities of companies in certain regulated industries, e.g., banking and railroading. However, Section 3 makes no distinction between exchange-traded securities and over-the-counter securities. The registration provisions apply to *all* companies with new stock issues. Listing is not a relevant criterion. Section 4 (concerning exempted transactions) also does not distinguish between exchange-traded securities and over-the-counter securities.

Similarly, Section 11 of the '33 Act, which provides civil liability for material misstatements or omissions in registration statements, applies to both exchange-traded securities and over-the-counter securities. Some of the antifraud provisions of the act are even broader. Sections 12(2) and 17(a) apply to almost all securities, whether or not within the '33 Act's registration provisions, and whether or not the security traded is on an exchange. In summary, the provisions of the '33 Act did not distinguish between exchange-traded securities and over-the-counter securities.

Control Group vs. Treatment Group

Chow's [1983] discussion of the '33 Act is ambiguous. At one point, he appears to recognize that the Act applies to new issues of *all* publicly traded companies, but he ignores this fact in selecting a control and a treatment group. His central hypothesis seems to be based on several statements that are misleading or inaccurate with respect to the '33 Act. For example, Chow [1983, p. 486] writes that the '33 Act "required exchange-listed firms to register new security issues with the Federal Trade Commission (FTC)." While this statement is true, it might be read to imply that this requirement did *not* apply to OTC companies; it did. It also is not accurate to suggest that companies might "delist" to avoid anticipated "high costs under the Securities Acts" [Chow, 1983, p. 492]. While companies could avoid costs imposed by the '34 Act by delisting, they could not use this strategy to avoid costs imposed by the '33 Act.[9] The above statements, false with respect to the '33 Act, serve as the basis of the central hypothesis of the Chow study.

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[7] Chow [1983, p. 488, footnote 13] lists the variables found in accounting debt covenants; those variables come from annual reports. Knauss [1968, pp. 404-406] points out that "since these new issues were not listed on an exchange, there was no requirement for continuous reports" and that the legislation was not expected to have an impact on annual reports.

[8] See Securities Act of 1933, preamble.

Chow [1983, p. 497] compares the portfolio return comparisons on "returns to the control firms (OTC companies) *which should not have been affected by the Acts* and the treatment portfolio of listed stocks (NYSE companies), *which is hypothesized to have been affected*" [emphasis added]. The '33 Act affected both OTC and NYSE companies; therefore, OTC companies are an inappropriate control group.[10] Since Chow compared returns of two "treatment" groups, it is impossible to determine what he tested. But it seems reasonable to conclude that the absence of a control group precluded him from testing the impact of the '33 Act.[11] The fact that he found significant differences suggests the existence of some exogenous variable.

Absence of a control group raises significant questions about the validity of Chow's test results and his conclusions that the '33 Act "reduced returns to exchange-listed stocks" and that this is "consistent with the '33 Act having significant out-of-pocket costs, having affected the competitive relationships across firms, or having reduced firms' available investment, financing, and production opportunities by tightening existing accounting-based debt covenants" [Chow, 1983, p. 514]. The author acknowledges in a footnote that he may not have had a control group for the '33 Act, but he argues that absence of a control group would not matter since this would bias results against confirmation of his hypotheses [Chow, 1983]. We do not believe that the direction of the bias is obvious.[12] But even if the apparent lack of a control group does not matter, as Chow contends, serious questions remain about the specification of the time period of the study.

DURATION: THE UNANTICIPATED EVENT THESIS

Specification of the duration of the event period is a critical part of any historical inquiry, for it determines the temporal sequence that should be examined.[13] Once an appropriate time period has been determined, then historical methods offer certain basic rules with respect to selection and evaluation of evidential matter. The scope of the inquiry must be sufficiently comprehensive to include examination of all events that could reasonably be posited to have contributed to passage of a particular regulation, and the objectivity of sources must be evaluated. While it is beyond the scope of our study to examine events prior to July 1932, the starting point of Chow's inquiry, it should be noted that this starting point is arbitrary.[14]

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[9] The ambiguity continues throughout the Chow study. See footnote 36 [Chow, 1983, p. 503], which states: "The Acts could have benefited the OTC firms with a shift in competitive advantage to them, given that listed firms would have to disclose more financial data." Once again, this is true for the 1934 Act, false for the 1933 Act.

[10] Historical secondary sources generally conclude that the '33 Act was designed to control abuses by nonlisted companies. For discussion of objectives, see Schlesinger [1958], Sargent [1981], and Seligman [1982]. See also Frankfurter [1933], Douglas [1940], and Landis [1959] for accounts by participant sources. For implementation, see MacRitchie [1983], who examined enforcement proceedings under the '33 Act and found that very few NYSE companies were the targets of enforcement proceedings.

[11] If the OTC companies in the Chow sample fell under the small-issue exemption for issues of less than $100,000 over a specified time period, generally one year, they might be an appropriate control group. We examined the OTC companies, listed in the *WSJ* [December 31, 1935], and selected 20 companies that met Chow's criteria. The average asset size of these OTC companies was $13,190,980; it would not appear that they would fall under the small-issue exemption. Future researchers may wish to take note that OTC companies with new issues may be the appropriate treatment group. Knauss [1968, p. 412] states that after passage of "the Securities Act, new issues were not distributed through exchanges and at least their initial trading had to be in the over-the-counter market."

[12] The argument Chow makes is that if OTC companies were subject to the regulation, i.e., an inappropriate control group, then he should not be able to show that regulation had an adverse impact on NYSE companies. Our later discussion of the Morgan hearings and other events, occurring during Chow's last two favorable periods, explains why those hearings would have had a greater impact on NYSE firms than on OTC firms. This further confounds prediction of the direction of the bias.

From a historical perspective, the crash of 1929 may be viewed as a catalyst, mandating some form of action to restore confidence in the securities markets [Andrews, 1932; Schlesinger, 1958]. Thus, it would seem appropriate to consider events subsequent to the crash as part of the antecedent period, leading to passage of the '33 Act. Events such as the Senate Banking and Currency Committee's investigation of the securities industry in the Spring of 1932 should not be ignored. Disclosures of alleged securities abuses received widespread publicity. The impact of these disclosures needs to be examined and a determination made as to whether or not they changed investors' expectations about the probability of securities legislation.[15] We suggest that future researchers examine this antecedent period before specifying a time frame for testing the '33 Act.

Chow examined reports in the *Wall Street Journal* (*WSJ*) and the *Commercial and Financial Chronicle* (*CFC*) from July 15, 1932 to March 1933 to verify his thesis that legislation was not anticipated until March 1933. He reported that he found no "mention of impending federal securities regulation";[16] therefore, he concluded that "it seems reasonable to assume that the '33 Act was generally unanticipated" [Chow, 1983, p. 486]. Given the critical importance of the thesis that legislation was "generally unanticipated" until March 1933, we believe that a more rigorous historical inquiry was in order. The failure to assess the objectivity of sources or to examine events in the political sector leaves the unanticipated-events thesis unsubstantiated.

Objectivity of Sources

An important factor in historical analysis is evaluation of the credibility of evidential matter [Hansen, 1979; LaCapra, 1986]. Chow does not evaluate

[13] See Porter [1981] for discussion of duration and how specification of an event affects both the temporal sequence and level of abstraction of an inquiry. Since Chow's objective is to examine the short-term impact of a specific event, passage of legislation [1932–34], the inquiry will be at a low level of abstraction; i.e., focus on institutions, individuals, and groups, and temporal sequence should be of a short duration. Antecedent and subsequent periods should be approximately the same duration, i.e., antecedent conditions [1929–31] and subsequent impact [1935–37].

[14] A review of historical secondary sources would appear to be a logical starting point for a study of securities regulation; see Schlesinger [1958], DeBedts [1964], Parrish [1970], Sargent [1981], and Seligman [1982]. See Mandelbaum [1977] for discussion of evaluation of evidential matter.

[15] Chow begins his investigation in July 1932, immediately after the Senate committee recessed for the 1932 political campaign. The *New York Times Index* contains numerous references to the Spring 1932 hearings; see, for example, front page coverage of Fiorello LaGuardia's [April 26, 1932] dramatic testimony [*New York Times*, April 27, 28, 1932]. See Seligman [1982], who concludes that LaGuardia's testimony discredited Hoover's voluntarism, ensuring that the hearings would be reconvened in January 1933 and that the Democrats would make securities regulation a campaign issue.

[16] Two articles, related to proposed securities legislation, did appear in the *CFC* during this period. On August 27, the *CFC* outlined Roosevelt's nine-point program to restore confidence in the economy. The first three points focused on securities regulation [*CFC*, August 27, 1932, p. 1429]. On October 1, an article discussed the need for regulations to curb the operations of speculators, manipulators, and financiers [*CFC*, October 1, 1932, pp. 2266–67].

the objectivity of his sources. He examines two business-oriented publications presumably because they would best reflect investors' attitudes. But the use of two business journals that opposed Roosevelt's candidacy and New Deal reforms introduces the problem of potential source bias. The use of a negative criterion, i.e., absence of articles related to securities regulation, compounds the potential bias problem. The absence of articles may have reflected efforts to "stonewall" proposed legislation, rather than absence of demand for regulation. A review of the popular press suggests that this may have been the case. During the period when Chow reports that he found no articles in his sources related to securities regulation, the *New York Times Index* [1932, 1933] contains numerous references, under various subtitles, to events related to securities regulation.[17] Examination of the *Times Index* would result in rejection of the "unanticipated" thesis.

The obvious question, from a historical perspective, is: "Was use of such a restrictive sample appropriate?" We believe not. First, from a simple cost/benefit standpoint, it would seem to have been more efficient to use a standard reference, such as the *New York Times Index*. Not only would use of the *Index* have reduced search costs, it would have provided a brief comment about articles related to proposed securities regulation. Second, examination of a daily newspaper would have been more consistent with the author's statistical tests since he examined daily returns and included Saturdays and Sundays in his five-day test periods.[18] Third, regulation is a political phenomenon; therefore, it would seem appropriate to include at least one source that provided broad-based coverage of events in the political sector.

Chow examines one other source, the accounting profession, to attempt to corroborate his "unanticipated" events thesis. Once again, he does not consider the problem of source bias. Chow [1983, p. 486] cites a statement by John Carey that "the '33 Act caught the profession by surprise" to show that legislation was unanticipated. Degler [1963] points out the dangers of not evaluating the credibility of public statements of participant sources. Carey, Secretary of the American Institute of Accountants (AIA) at the time of passage of securities legislation, may not have been an objective observer. If he stated that legislation had been anticipated, this would have raised questions about the adequacy of the Institute's response. His statement needs to be corroborated by examination of other evidential matter.

An examination of the correspondence of the AIA Committee on Cooperation with the New York Stock Exchange and the AIA *Minutes* suggests that accountants had anticipated legislation prior to March 15, 1933. In his initial communication with George O. May suggesting cooperation between accountants and the New York Stock Exchange, J. M. B. Hoxsey [1931], Secretary of the NYSE, indicated that he believed public opinion would mandate some form of regulation, but that voluntary reforms would be beneficial in that they might deter "unwarranted" government intrusion.[19] It seems unlikely that accountants did not recognize that changes in the political environment would accelerate demands for some type of regulation.

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[17] The references in the *New York Times Index* to the 1932 political campaign and Roosevelt's post-election plans contain numerous references to demands for securities regulation. Roosevelt called for securities legislation in his acceptance speech at the Democratic convention and continued to do so continuously throughout his campaign. After his landslide victory, Roosevelt's efforts to strengthen the Senate investigating committee received widespread publicity. See the *New York Times* [January 26, 1933] for discussion of Pecora's appointment and its implications. See, also, January 29, January 31, and February 2 issues of the *New York Times* for discussion of expansion of the scope of the investigation and expansion of Pecora's authority.

[18] The *Wall Street Journal* did not appear on weekends, while the *Commercial and Financial Chronicle* appeared weekly.

The Political Environment

Although regulation is a political phenomenon and a heated political campaign was being waged during the latter half of 1932, Chow does not examine events in the political sector. It seems reasonable to suggest that events such as (1) enactment of a strong plank calling for securities regulation in the 1932 Democratic platform, (2) Roosevelt's strong advocacy of this plank in his nomination speech and in speeches throughout his campaign, and (3) Roosevelt's landslide victory may have had an impact on investors' expectations.[20] Similarly, Roosevelt's actions as President-elect to strengthen the Senate committee investigating the securities markets and the impact of continuous disclosures of alleged securities abuses reported during Senate hearings (January-March 1933) need to be considered.[21] Failure to examine activities in the political sector during the control period is a major omission in the Chow study.

Our brief historical overview suggests that important events occurred between July 1932 and March 1933 that were not neutral; i.e., not likely to impact investors' expectations about the probability of passage of legislation. If one assumes that stock market prices anticipate legislation, as Chow does, then a rigorous historical inquiry should be considered an integral part of specification of an appropriate test period. From an historical perspective, two major deficiencies exist in the Chow study. Failure to assess the objectivity of sources—a critical procedure when one adopts a negative (absence of articles) classificatory criterion—combined with the omission of any examination of events in the political sector, precludes Chow from substantiating the critical thesis that legislation was "generally unanticipated" until March 1933. Since examination of the *New York Times Index* would have resulted in rejection of the unanticipated-events thesis, based on Chow's own criterion, we suggest that his test period is misspecified, rendering the results of his statistical tests subject to various interpretations.

THE TEST PERIOD

Once an event has been defined and external relations examined during the antecedent period, historical inquiry can be used to examine the internal structure of an event, i.e., the interrelations between its constituent elements [Porter, 1981]. Events studies usually require assessment of the market impact of various phases of an event if results are to be interpretable.[22] In this section, we examine Chow's classificatory criteria and his classification of events during the test period from an historical perspective. To avoid redundancy, we do not repeat our criticisms, related to source bias, but they also apply to the evidence used to support selection and classification of events during the test period.

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[19] See Merino and Neimark [1982] for discussion of the use of "voluntary" reforms as a means of deterring draconic governmental action. See also Andrews [1932], who suggests that the exchanges may have waited too long to enact reforms and concludes that compulsory audits by exchanges would not satisfy or silence the demand for state regulatory action. Andrews' paper was delivered in October, before Roosevelt's landslide victory.

[20] Given Roosevelt's commitment to securities legislation, the impact of his landslide victory on investors' expectations about the likelihood of legislation needs to be examined. McCraw [1984, p. 159] concludes that "after the presidential election of 1932, federal securities legislation became inevitable"; Schlesinger [1958] and Parrish [1970] reach similar, but more cautious, conclusions.

[21] Other events that need to be examined in the post-election period include the Insull collapse (November 1932) and the National City Bank hearings (February 1933). See Pecora [1939] for an overview of the Spring 1933 investigations and Seligman [1982], who concludes that disclosures at the National City Bank hearings solidified public opinion so that passage of securities regulation in the special session (March 1933) was assured.

Chow classifies each of the days in his test period as "favorable," "unfavorable," or "control." He assumes that a semistrong efficient market existed prior to passage of securities regulation; therefore, he posits that a stock market price reaction to favorable or unfavorable events would occur within a five-day period.[23] His test period extends from March 17 to June 5, 1933.[24] Classification is based on reports related to securities regulation in the *WSJ*. The author identifies critical events—i.e., events that could be expected to have a significant market impact—then subjectively selects 11 critical dates and classifies each as "favorable" or "unfavorable" [Chow, 1983].

The classification criteria are that an event occurred that "significantly affected market assessment of its probability of enactment *and/or* the stringency of its accounting requirements." Thus, a date was "favorable" if an event occurred that "increased the Act's assessed probability of enactment *and/or* accounting stringency" and unfavorable if an event occurred that "decreased the Act's assessed probability of enactment *and/or* accounting stringency" [Chow, 1983, p. 494]. The test period also includes a 40-day control period with a control date being a date on which there was no report in the *WSJ* concerning securities legislation.[25]

Chow's classificatory criteria ignore the role that compromise plays in legislative process in the United States. This omission appears to confound his favorable/unfavorable classifications. The problem rests with the *and/or* categorization. A *decrease* in stringency of a controversial provision often reflects compromise which *increases* the probability that some form of legislation will pass. The *and/or* dichotomy precludes such a possibility; Chow's criteria mandate a direct relation (*increase/increase*) between stringency and probability of passage, whereas compromise would suggest that the relationship might be inverse (*increase/decrease*). While decreased compliance costs might result in increased stock market prices, if the compromise made the probability of passage more likely, this would be expected to result in decreased stock market prices. The overall effect is indeterminate, but historical analysis does enable us to examine an event and to make an informed judgment about the net impact it might have had on stock market prices.[26] We examine Chow's one "unfavorable" period, based on the decreased stringency of the accounting provisions of the '33 Act, to highlight the complex nature of the classificatory problem.

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[22] See Leftwich [1981], who avoids making *a priori* assessments by use of an expectations model that enables him to classify events into two categories—revisions of expectations or no revision of expectations. He then analyzes the former to determine the impact of revised expectations. But see Brown [1987] for criticisms of this approach, specifically the difficulty of interpreting results when priors have not been specified.

[23] Chow [1983] recognizes in a footnote that a five-day event period may not fully capture the effects of an event in the pre-SEC market. The problem is exacerbated by his inclusion of Sundays and holidays in the five-day test period. Comparing Chow's test period to a 1933 calendar, we found that the 30 favorable days include five Sundays (16.6 percent of the test days). The 11 unfavorable days include a Sunday and Good Friday (18.8 percent of the test days), and the 40 control dates include five Sundays and Memorial Day (15 percent of the test days). Since securities markets were open on Saturday mornings, we did not exclude Saturdays; but the short trading session also might have an impact on the viability of the five-day window that Chow uses.

[24] It is not clear whether Chow examined the *WSJ* during the first 15 days of June, since he writes that he examined the *WSJ* from "July 1, 1932 to May 30, 1933"; however, Exhibit 1 (p. 515) indicates 16 of the 40 control days are after May 30 [Chow, 1983, p. 494].

[25] We do not examine specification of control dates within the test period, since the same criticisms of source bias and omission of the political sector apply. For example, it is difficult to accept the period from May 9-20 as "control" dates when one examines the *New York Times*. Numerous references appear to the conference committee's work and to final agreement (May 17) that had been reached by the conferees. Similarly, the May 30 to June 15 period needs closer examination, since the Morgan hearings continued and accelerated demands for regulation of the NYSE. Since Chow [1983, p. 495] assumes "that security returns on both event and control days would reflect the influence of other economic factors, while their differences would reflect the Securities Acts' impacts," misspecification of control dates raises another interpretation problem.

Unfavorable or Favorable—[April 4-14]?

Chow classifies the period from April 4-14, 1933 as "unfavorable" due to revisions that *decreased* the accounting stringency of the '33 Act.[27] He argues that decreased compliance costs should be expected to result in *increased* stock market prices. However, if decreasing the stringency of some of the more controversial provisions of the '33 Act reflected compromise, as Seligman [1982] suggests, then this could have increased expectations that legislation would pass. A key question from a historical perspective is: "Did stock market prices fully reflect anticipation of some form of regulation prior to this date?" If stock market prices did not fully reflect anticipation of regulation prior to April 1933, then the historical record would suggest that this period should be regarded as favorable.

In his March 29, 1933 message to Congress, Roosevelt proposed securities legislation limited to new issues.[28] He made it clear that he expected legislation to be passed and passed quickly. The *New York Times* [March 30, 1933, p. 8] predicted quick Congressional action and reported that Wall Street appeared willing to cooperate. But open hearings and demands that the regulation be extended to all outstanding issues rekindled criticisms of the Senate (Thompson) bill. On April 5, when the open hearings ended, Rayburn convinced Roosevelt that the Senate bill was too harsh and compromise was needed [Sargent, 1981]. On April 6, one of Chow's critical "unfavorable" dates, the popular press reported that Roosevelt had called Richard Whitney [NYSE] to Washington to discuss the final form of the legislation. The *New York Times* [April 6, 1933, p. 3] concluded that Roosevelt's intent was to make the bill conservative enough to ensure quick passage.

The selection of Felix Frankfurter to direct revision of the bill, combined with selection of Rayburn to be the legislative floor leader, were critical events that greatly enhanced the probability of passage of legislation [Landis, 1959]. Frankfurter arrived on April 7 and three days later the House Commerce Committee received the revised legislation. In directing the bill through Congress, Rayburn showed the type of political acumen for which he would become noted. To avoid direct confrontation with Thompson, the author of the Senate bill, the drafters of the House bill described it as "perfecting amendments," not new legislation [Sargent, 1981, p. 218]. By April 12, Chow's last "unfavorable" date (increase in stock market prices expected), many compromises had been reached. The House's perfecting amendments, unlike the Thompson bill, did not generate criticism from Wall Street. A letter to the editor in the *Times*, titled "the sobering effect of pending legislation on the financial community," captured the impact of events of the only "unfavorable" period in Chow's study [*New York Times*, April 15, 1933, p. 12]. Historians generally conclude that events of this period ensured passage of some form of securities regulation [Schlesinger, 1958; Parrish, 1970; and McCraw, 1984].

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[26] See Potter [1973, p. 15], who discusses how historians determine significance of events from a multiplicity of factors; he maintains that "the significant ones (events) are the ones without which the event would not have occurred." For example, historians might conclude that Roosevelt's message limiting regulation to new issues, removal of the FTC's veto power, and reducing directors' liabilities were significant events; i.e., favorable since they increased the probability of passage of the '33 Act. These are the same events that Chow cites as "unfavorable"; i.e., reduction of compliance costs.

[27] Chow's [1983] selection of critical "unfavorable" events indicates that he has a broad definition of accounting requirements. His "unfavorable" focuses on actions in the Thompson bill in the Senate, rather than on the House bill that finally passed. See Landis [1959], Sargent [1981], and Seligman [1982] for discussion of efforts to make the '33 Act less controversial and Roosevelt's support for the House bill.

[28] Roosevelt's decision to limit regulation to new issues stilled many critics; if a market reaction (reduced compliance costs) were to occur, it would seem reasonable to suggest it would occur near this announcement. The *New York Times* [April 1, 1933, p. 3] reported efforts to extend the bill to all outstanding issues and that the framers would insist that it be limited to new issues. Chow cites the limitation to new issues as a "critical" unfavorable event, he classifies April 10, when the Senate agreed to Roosevelt's plan, as "critical" unfavorable date related to new issues.

An alternative scenario is possible: stock market prices may have reflected anticipated legislation prior to April 4, making classification, based on decreased compliance costs, appropriate.[29] However, it is not clear that events during the period did, in fact, result in decreased stringency of the accounting provisions of the legislation. Chow [1983] focuses on the provisions of the Senate (Thompson) bill to determine the stringency of the '33 Act.[30] The House draft, which eventually became law, is ignored. The Frankfurter team enacted some key compromises (scaling down the absolute liability provisions for directors and limiting the authority of the FTC to veto new issues) that had made the Senate bill controversial. These compromises appeared to appease critics, but it could be argued that the House draft increased stringency of the accounting provisions. The House bill gave the FTC the right to define accounting principles, expanded the number of mandated disclosures from nine to 32 categories, and extended the scope of the liability provisions to include experts, such as accountants.[31] Perhaps, due to closed-door hearings, these accounting changes did not raise vociferous objections.

The historical record suggests that events of this period should be classified as favorable, i.e., the impact of passage of legislation outweighed the decreased costs associated with changes in the Thompson bill. The *Wall Street Journal* [April 10, 1933, p. 1] concluded that the necessary compromises had been made and that legislation would be forthcoming shortly. If this is an accurate judgment, then stock market prices should have reflected anticipated legislation prior to final passage of the legislation. This raises serious questions about the propriety of subsequent favorable May classifications, based on unanimous passage of the House bill (May 6) and House (May 23) and Senate (May 25) passage of the Securities Act of 1933.

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[29] It is possible that by the end of March 1933, investors anticipated regulation, and that this was reflected in stock market prices. As mentioned earlier, the *New York Times* concluded that legislation would pass quickly after Roosevelt's message in March. The *Wall Street Journal* [March 31, 1933, p. 1] reached a similar conclusion, acknowledging that the financial community had conceded regulation would be forthcoming.

[30] See Chow [1983] for changes in the Senate bill that result in "unfavorable" classification, due to decreased stringency.

[31] See McCraw [1984] for discussion of why the Frankfurter team expanded the number of categories of disclosures from nine to 32 and the rationale for extension of liability provisions to experts. See, also, Schwartz [1973], who McCraw cites as his legislative history source, and Landis [1959] for legislative intent.

Passage of Legislation— [May 21-27]

Chow's last favorable (decrease in stock market prices) events period (May 21-27) adds a significant imponderable to interpretation of the results of his study. Passage of the '33 Act by the House (May 23) coincided with the start of the investigation of the House of Morgan. These hearings received extensive and sensational newspaper coverage.[32] The popular press avidly reported abuses of power associated with investment bankers' dealings in securities issues on New York Stock Exchange. Disclosures of the fact that Morgan paid no income tax (May 24), that Morgan & Co. had a preferred customer list (May 25), and publication of the preferred customer list (May 26) with subsequent disclosure of large windfall profits to insiders (May 27) outraged public opinion.[33] An editorial in the *New York Times* [May 27, 1933, p. 8] reflected public sentiment, concluding that investment bankers and the NYSE had abdicated their fiduciary responsibilities, and thus forfeited the right to remain unregulated. Reporting on securities legislation clearly was overshadowed by the Morgan hearings; House and Senate passage of the bill received little attention in the popular press.

The disclosures at the Morgan hearings not only generated demands for additional regulation directed at stock exchanges, they had an immediate legislative impact. The Senate unexpectedly passed the Banking Act of 1933, three days after the Morgan hearings began.[34] Roosevelt did not support the Senate banking bill and the conservative press vehemently opposed this legislation; its passage caught both the president and Wall Street off guard [Seligman, 1982; Sargent, 1981]. The Banking Act required commercial banks to divest themselves of their security affiliates and divorced commercial and investment banking.[35] The strong negative abnormal returns that Chow found during this period may have reflected reaction to the unexpected passage of the banking act or anticipation of the '34 Act, rather than unanimous passage of the '33 Securities Act.[36]

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[32] *Time Magazine* [June 5, 1933, p. 38] conveyed the magnitude of the Morgan coverage, stating that "the big wild hare that was started by Banker Morgan . . . bounded across the front pages of the nation's papers for the rest of the week, leaving a redolent back trail of streamer headlines." Pecora [1939, p. 5] writes that "public interest in his [Morgan's] appearance was almost hysterically intense"; see also DeBedts [1964], who documented the widespread newspaper coverage that the hearings received throughout the nation.

[33] See *New York Times*, May 23, 24, 25, 26, 27, and 28, for indication of the importance of the story. The *Times* had a front-page story and two to three additional pages in the front section each day.

[34] See Sargent [1981] for discussion of why adverse publicity at the Morgan hearings enabled a diverse coalition of proponents to enact a banking reform, which Roosevelt did not favor. See *New York Times* [May 25, 1933, pp. 1, 6-8] for an article about passage of the Glass Bank Bill by the Senate. The article had a subhead in bold print, "Morgan Hearing A Factor."

[35] The Glass Bill forced commercial banks to divest themselves of their security affiliates and private banking houses, such as J. P. Morgan & Co., to give up either their investment business or receipts of deposits. Not only was passage unexpected, the Senate reduced to one year the time in which such divestitures must occur [*New York Times*, May 26, 1933, p. 1]. See Willis and Chapman [1934] and O'Connor [1938] for further discussion.

[36] Since Chow [1983] uses gross returns, this is a real possibility; he argues that if other economic events had increased market-wide returns in a favorable period, OTC firms (control) would mirror these market changes more substantially because they were significantly smaller than NYSE firms. But the Morgan hearings would have had a greater impact on NYSE firms. We do not accept the argument that misclassification would not matter since "erroneous inclusion of non-critical events and exclusion of critical ones would bias the results toward nonsignificance" [Chow, 1983, p. 494]. If there is misclassification of favorable/unfavorable/control dates, the direction of the bias is indeterminate

CONCLUSIONS

Our primary objective has been to show the importance of conducting an adequate historical analysis to support the research design used in an events study. An adequate historical inquiry requires specification of an appropriate temporal sequence, evaluation of objectivity of sources, and analyses of all events that could have an impact on investors' expectations. Assessment of the impact of a political phenomenon, such as regulation, requires an adequate examination of activities in the political sector and use of classificatory criteria consistent with attributes, such as compromise, of the political process.

With regard to the Chow [1983] study, we conclude that (1) lack of a control group, (2) an unsubstantiated test period, and (3) misclassification of favorable/unfavorable/control dates during the test period make the results of the empirical tests subject to various interpretations. We suggest that these problems may invalidate the author's conclusion that the "evidence is consistent with the '33 Act having significant out-of-pocket compliance costs, having affected the competitive relationships across firms, or having reduced firms' available investment, financing, and production opportunities by tightening existing accounting-based debt covenants" [Chow, 1983, p. 514].

We urge that future researchers cite the Chow paper with caution. Watts and Zimmerman [1986, p. 173] write that "for example, Chow [1983] finds that the 1933 Securities Act reduced the wealth of shareholders of firms that were affected by the act relative to those firms not affected by the act (OTC stock)" and conclude that "*hence, there is evidence* that regulation imposes private (e.g., the stock price effects) and social costs (e.g., the resources spent by the SEC) and little evidence of benefits" [emphasis added]. The authors do not cite any other empirical study to support this very strong conclusion; our analysis suggests that such a conclusion, based on the Chow study, may be unwarranted.

Historical analysis enables researchers to examine the external relations created by an event to enhance the construct validity of their research design. It also allows them to examine the internal structure (constituent elements) of an event and to make classifications about the impact of those constituent elements on an informed basis. If the objective of a study is to explain the impact of a particular event, then hypotheses (causal propositions) should be subject to historical scrutiny to determine that posited relations reasonably reflect the actual relations generated by the event. If the posited relations do not hold, then the hypotheses should not be used to interpret the results of empirical tests. Future accounting events studies should be based on adequate historical analyses; if this is not done, then research may distort, rather than enhance, understanding.

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The Effect of Earnings Yields Upon the Association Between Unexpected Earnings and Security Returns: A Re-examination

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ABSTRACT: This paper re-examines Basu's [1978] finding that earnings yields are related to the unexpected earnings-security returns association in a manner consistent with biased investor expectations of earnings. The results indicate that those early findings were due to (1) a classification bias inherent in the market index earnings expectation model used, and (2) failure of the returns conditioning model to incorporate a share price effect on security returns. Both factors in the research design have implications for contemporary studies of the unexpected earnings-security returns association.

THE empirical association between accounting earnings and security returns has been studied extensively for two decades (summarized in Brown, Foster, and Noreen [1985]). Recent studies have incorporated firm-specific characteristics that appear to affect either the strength or the direction of the market's response to unexpected earnings. For example, Basu [1978] found that the association between unexpected earnings and security returns is related to earnings yields (earnings/price) in a manner consistent with biased investor expectations of earnings. Other studies indicate that the strength of the market's response to earnings is related to factors such as firm size [Atiase, 1985; Freeman, 1987] and exchange listing [Grant, 1980]. Overall, these findings imply that such firm-specific characteristics must be controlled for in studies dealing with the unexpected earnings-security returns association.

The purpose of this paper is to assess whether, in view of recent findings, Basu's [1978] early results concerning earnings yield were a necessary consequence of two features of the research design. These features were: (1) a classification bias inherent in the earnings expectation model used, and (2) failure of the return conditioning model to con-

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trol for a "share price effect" reported in recent studies of security return behavior (e.g., Blume and Husic [1973]; Kross [1985]). This paper demonstrates that *either* of these factors would bias the empirical results in a manner supporting the biased investor expectations of earnings hypothesis. It is shown empirically that when a suitable model for expected earnings is used and the influence of share price upon security returns is controlled for, there is no significant relation between earnings yields and the unexpected earnings-security returns association.

Although we directly address only the earnings yield effect, there are two broader implications for empirical research. First, the use of mechanical earnings expectations models instead of financial analysts' forecasts may bias results when sample firms are partitioned on a variable that may proxy for expected next-period earnings growth. Second, a failure to control for share price-security return association may induce a spurious association or otherwise confound the empirical results. The latter is especially likely in studies that examine the association between security returns and accounting variables, where either share price or market capitalization is used to deflate the accounting variables.

The remainder of this paper is organized as follows. Section I explains the classification bias induced by use of the time-series/cross-sectional "market index" model of earnings expectations; section II documents the influence of share price upon security returns for the firms and time periods included in this study; section III re-examines the effect of earnings yield upon the unexpected earnings-security returns association; section IV concludes the paper with a discussion of implications for future research designs.

I. Earnings Expectations Models and Classification Bias

Examination of the association between unexpected earnings and security returns requires a suitable measure of the security market's expectation of earnings. Prior studies have relied upon either time-series models (e.g., Watts [1978]; Beaver et al. [1979]; Foster et al. [1984]) or upon published financial analysts' forecasts (FAFs) (e.g., Abdel-khalik and Ajinkya [1982]; Fried and Givoly [1982]; Brown et al. [1987a, 1987b]). Some studies have attempted to determine whether time-series models or FAFs better proxy for the market's earnings expectations. Fried and Givoly [1982] compared the market reaction to unexpected annual earnings, where the expected earnings were measured using FAFs and two separate time-series models, and concluded that unexpected earnings based on FAFs have the highest correlation with abnormal returns. In a comprehensive comparison of quarterly unexpected earnings measures based upon FAFs and three univariate time-series models, Brown et al. [1987a, 1987b] report that analysts' forecasts are a better single proxy for market earnings expectations and suggest that researchers use FAFs rather than time-series models as a proxy for market earnings expectations.

In general, the use of time-series models in lieu of FAFs as a proxy for market earnings expectations would decrease the efficiency of statistical tests. Thus, other things equal, the hypothesis that unexpected earnings and security returns are unrelated would be more difficult to reject. However, in studies that incorporate firm-specific characteristics that are expected to associate with expected earnings growth, additional biases are introduced. For example, Basu [1978] used a time-series/cross-sectional "market index" model as a proxy for expected earnings, and then used earnings yield, the reciprocal of the price-earnings ratio, to categorize firms. Yet, Beaver and Morse [1978] have documented that price-earnings ratios correlate negatively with (one-period) earnings growth in the year that the ratio is measured, and correlate positively with earnings growth in the ensuing year. They attribute the result to transitory components in reported earnings and the resulting pricing by the market.

Basu [1978] hypothesized that earnings yield affects the market's response to earnings reports: "good news" firms (those with actual earnings in excess of expected earnings) with high earnings yields will outperform good news firms with low earnings yields, because the good news for the latter firms has been partly anticipated. Conversely, "bad news" firms (those with actual earnings below expected earnings) with low earnings yields will underperform bad news firms with high earnings yields because the bad news for the latter firms has been partly anticipated.

Although Basu's empirical results confirmed his expectations, given knowledge of recent developments, they were to be expected even if no market earnings expectation biases were associated with earnings yield and there was no earnings yield anomaly. The same results would occur solely due to classification bias induced by using an earnings expectation model that does not exploit the relation between price-earnings ratios and subsequent earnings growth. Such a model is more likely to *under*estimate the market's earnings expectation for low earnings yield firms, and is more likely to *over*estimate the market's earnings expectation for high earnings yield firms.[1]

To investigate the empirical importance of this bias, the following criteria were used to identify a sub-population of December fiscal year-end firms for analysis. The sub-population members had available: (1) a complete history of returns on the CRSP daily return file for January 1977 through March 1982, to enable the estimation of abnormal security returns as described below; (2) forecasts of earnings in year T available in *The Value Line Investment Survey* by March 31 of year T ($T=1978$ through 1981); and (3) suitable data on the *Value Line* and COMPUSTAT files from 1971 through 1981, to enable measurements of the firm-specific variables described below.

Two measures of earnings expectations were initially used. The first measure was the time-series/cross-sectional market index model used in prior research. The second measure was the latest *Value Line* forecast of expected annual per-share earnings for year T, available as of March of year T.

Basu [1978] used the following "market index" model in first difference form:

$$\tilde{E}_{j,T}-E_{j,T-1}=a_j+b_j(\tilde{E}_{m,T}-E_{m,T-1})+\tilde{e}_{j,T} \qquad (1)$$

where $\tilde{E}_{j,T}$ is firm j's accounting income (before extraordinary items) in year T divided by the book value of common equity at the end of period $T-1$, $\tilde{E}_{j,T-1}$ is

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[1] As pointed out to us by one anonymous reviewer, because the book value of equity is used to deflate the earnings measure, a negative shock to earnings in year $T-1$ will not only affect the expectation of earnings for year T, but will reduce the book value of equity at $T-1$, so that earnings scaled by the book value of equity in period T is even more upwardly biased than if an unscaled earnings measure alone was used.

TABLE 1

CORRELATIONS AMONG EARNINGS YIELD, ACTUAL EARNINGS GROWTH, AND FORECASTED EARNINGS GROWTH: MARKET INDEX MODEL AND *Value Line* FORECASTS

	Product Moment Correlations	
Variables	*Market Index Model*	Value Line *Forecasts*
Actual and forecasted earnings growth	−.029	+.546*
Earnings yield and forecasted earnings growth	+.141*	−.352*
Earnings yield and actual earnings growth	−.283*	

* Correlations are based upon 1,981 observations ($p<.01$). Earnings yield is measured at the end of T-1, actual and forecasted earnings growth are measured for year T (T=1978–1982).

the realized value for $T-1$, and $E_{m,T}$ is the sum of total "market" income divided by total "market" book value, at the end of year $T-1$. The intercept and slope parameters are a_j and b_j; $\tilde{e}_{j,T}$ is a random disturbance term. The unanticipated change in "earnings" in year T was then estimated as:

$$e_{j,T}=(E_{j,T}-E_{j,T-1})-\hat{a}_{j,T}-\hat{b}_{j,T}(E_{m,T}-E_{m,T-1}) \qquad (2)$$

where $\hat{a}_{j,T}$ and $\hat{b}_{j,T}$ are the estimated parameters, based upon all previous years of available data, beginning with 1972.

If expected earnings are measured using mechanical models that fail to consider the market earnings growth expectations implicit in price-earnings ratios, then a subsequent partitioning of sample firms based on earnings yields would reveal an apparent interaction between earnings yield and the market return effect of unexpected earnings. To estimate the empirical importance of this potential bias, the market index model's forecasted change in earnings was converted to a forecasted growth rate in earnings.[2] For purposes of comparison, *Value Line* forecasted growth rates were also computed.

Table 1 reports the associations between actual earnings growth rates and those estimated by the time-series model and the *Value Line* forecasts. Note the following:

(a) As reported by Beaver and Morse [1978], cross-sectional differences among firm's earnings yields are significantly negatively associated with next-period earnings growth. This is consistent with the view that actual earnings yield differ-

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[2] The growth rate implied by Basu's [1978] model for period T, G_{BT}, is:

$$G_{BT}=\left[\frac{(Y_{j,T}+E_{j,T-1})\times BV_{j,T}/NCS_{j,T}}{EPS_{j,T-1}}\right]-1.$$

where $Y_{i,T}=E_{j,T}-E_{j,T-1}$, the forecast using model (1); $BV_{j,T}$ is book value of common equity, $NCS_{j,T}$ is the number of common shares, and EPS_{T-1} is the per-share earnings in the prior year. All firms with negative earnings in year $T-1$ were deleted in computing earnings growth rates. Consequently, the correlations reported below are based upon 1,921 rather than 2,064 cases (516 firms × four years = 2,064 cases).

TABLE 2
PERCENTAGE NEGATIVE UNEXPECTED EARNINGS FOR LOW AND HIGH EARNINGS YIELD QUINTILES, MARKET INDEX MODEL, AND *Value Line* FORECASTS

Quintile	*Market Index Model*	Value Line *Forecasts*
Low earnings yield firms	.549	.521
High earnings yield firms	.637	.495
Difference	.088*	−.026

* Percentages are for approximately 400 cases per quintile ($p<.01$).

ences are due in part to transitory components in earnings.

(b) The growth rates implied by the market index earnings expectations model for period T are significantly positively correlated with earnings yield measured in $T-1$, and mildly negatively correlated with actual growth in period T. This is contrary to the notion that price-earnings ratios are positively associated with next-period earnings growth, but is to be expected if transitory components of earnings in period $T-1$ were in part responsible for earnings yield differences among firms.

(c) *Value Line* forecasted growth rates are highly associated with actual earnings growth, and also correlate negatively with earnings yield, as would be expected if earnings yield differences reflect transitory components in earnings.

To see whether the associations reported in Table 1 lead to misclassifications of firms based upon the sign of unexpected earnings, the percentage of negative unexpected earnings was tabulated for firms in the lowest and highest earnings-yield quintiles using the market index model and *Value Line* forecasts. These results are reported in Table 2. For the market index model, high earnings yield firms have a statistically significant classification difference between the top and bottom earnings yield quintiles; the *Value Line* forecasts do not have a significant difference. Moreover, the market index model has a higher percentage of negative unexpected earnings for high earnings yield (low price-earnings ratio) firms, which is what would be expected given the earnings growth implications of price-earnings ratios. High earnings yield firms with actual earnings above market expectations will tend to be classified as "bad earnings news" firms, so that unexpected earnings will be misclassified. The opposite effect will occur for low earnings yield firms.

In summary, the time-series/cross-sectional market index model used by Basu [1978] is subject to a bias that is associated with the earnings yields of the sample firms. The resulting misclassifications tend to produce empirical results consistent with the hypothesis that earnings yield disparities reflect biased expectations of earnings. *Value Line* financial analysts' forecasts do not include a similar bias.

II. SHARE PRICE AND ABNORMAL SECURITY RETURNS

The second issue related to the effect of earnings yield on the unexpected earnings-security returns association is the effect of share price. Recent research indicates that share price is a factor that is "priced" in the securities market [Blume and Husic, 1983], and the share price effect appears to subsume both the earnings yield and size effects upon abnormal security returns [Kross, 1985]. If so, there are two immediate implications for studies dealing with the association between unexpected earnings and security returns. First, because share price and abnormal return are inversely related, a failure to control for share price would cause an apparent positive relation between earnings yield (earnings/price) and abnormal return, lending spurious support to the hypothesis that earnings yield differences among firms reflect biased investor expectations of earnings.

The second implication of the effect of share price on returns arises because share price is frequently suggested as a deflator of accounting numbers in empirical research. Christie [1986] argues that share price (or the market value of shareholder equity) is the *only* correct deflator to measure the association between security returns and accounting variables. If there is a share price effect upon security return, however, then the numerator and denominator of the price-deflated accounting variable may have contrary implications for security valuation.

For example, the share price effect may either overstate or obscure the association between security returns and unexpected earnings deflated by share price. Firms with positive unexpected earnings and low share price (or with negative unexpected earnings and high share price) would tend to show a stronger positive association between unexpected earnings and security returns than would firms with positive unexpected earnings and high share price (or with negative unexpected earnings and low share price). In the former cases the numerator and denominator effects would be reinforcing, and in the latter cases the effects would be offsetting. This phenomenon may account at least in part for the relatively poor performance of the share price denominator, when compared to other deflators for unexpected earnings [Brown et al., 1987a, 1987b].

To assess the empirical importance of the share price effect for the firms and time periods included in this study, the 516 sample firms were assigned to one of five portfolios of approximately equal size, based upon share price (in dollars) at the beginning of the analysis period. Accordingly, the 20 percent of firms with the lowest share prices were assigned to price quintile one, and so on. Table 3 reports results of a one-way analysis of variance for each year individually and for the four years combined. In all cases, there are significant differences (at $p < .006$) in cumulative abnormal returns related to share price quintiles. Based upon these results, the statistical tests reported in the following section will be performed both with and without control for the share price effect.

III. UNEXPECTED EARNINGS AND ABNORMAL SECURITY RETURNS

This section assesses the effect of earnings yield on the unexpected earnings-security returns association using *Value Line* forecasts as measures of earnings expectations. The security return com-

TABLE 3

MEAN CUMULATIVE ABNORMAL RETURN BY SHARE PRICE QUINTILE, YEARLY AND FOUR YEARS COMBINED

	Share Price Quintile						
Year	*1*	*2*	*3*	*4*	*5*	*F-statistic*	(p)
1978	.011	−.036	−.061	−.011	.036	7.28	(.000)
1979	.127	.003	.024	−.016	−.034	3.78	(.005)
1980	.129	.067	.024	−.061	−.152	6.68	(.000)
1981	.257	.223	.053	−.052	−.254	18.33	(.000)
Four Years Combined	.131	.064	.010	−.035	−.101	32.96	(.000)

parisons are made both before and after controlling for the effect of share price upon security returns.

Measurement of Abnormal Security Returns

For the period January 1977 through March 1982, the CRSP daily return file was used to compute weekly return relatives for each firm as well as for the market; Fisher's equal-weighted index was used to proxy the market portfolio of risky capital assets. Weekly rather than daily returns were used to mitigate the potential bias caused by nonsynchronous trading [Reinganum, 1982].

Sharpe's [1964] market model, based upon natural logs of return relatives, was used to eliminate marketwide sources of return. The 50-week estimation period ending the last full calendar week of year $T-1$ was used for the calculation of abnormal returns for year T. Abnormal returns were estimated and cumulative abnormal returns (*CAR*s) were formed by aggregating weekly abnormal returns over the 12-month period beginning the first week in April of year T through March of year $T+1$. (For example, *CAR*s for 1978 are measured over the period April 1978 through March 1979.)

Two important assumptions underlie the estimation and statistical testing procedures used below: (1) abnormal security returns are generated from a single homogeneous population, and (2) abnormal returns do not exhibit cross-sectional correlation. Each of these issues will be addressed in turn.

Homogeneity of Variances

To the extent that individual firms have different residual variances, the homogeneity of variance assumption is violated. To remedy this potential problem, each abnormal return was standardized by its estimated prediction error using the technique described in Patell [1976, pp. 255–256]. The statistical tests described below were conducted using both the cumulative abnormal returns and the standardized abnormal returns as dependent variables, and the results were virtually identical. Because of their convenient economic interpretation, the results will be reported only for the cumulative abnormal returns.

Cross-sectional Dependency

Cross-sectional correlation of the abnormal return measures poses a potential problem that is likely to be less severe in cases where the event times differ for the sample firms and when the sample is diversified across many industries. The event times are assumed to be identical for all firms in this study. There is, however, considerable diversification across industries as measured by Standardized Industrial Classification (SIC) codes. Specifically, the 516 firms included here represent 208, 135, and 49 separate industries, at the four-digit, three-digit, and two-digit levels of SIC code aggregations, respectively.

The approach described in Collins, Rozeff, and Salatka [1982] was used to assess the severity of cross-sectional correlations of residual returns. The correlation matrix of unstandardized residuals from the estimation period was formally tested for departure from an identity matrix using the test statistic described in Morrison [1967, pp. 111–113], and it was not possible to reject the null hypothesis at any reasonable probability level.[3]

Based upon the standardization of abnormal returns described earlier and the results of the tests for cross-sectional dependence, the data seem suitable for analysis using conventional statistical tests that assume variance homogeneity and cross-sectional independence.

Statistical Tests

The dependent variable used in the following statistical tests is the cumulative abnormal return. The test results will be reported both with (eq. 3) and without (eq. 4) control for the share price effect using the following design:

$$CAR_{ijk}=\mu_{..}+\alpha_i+\beta_j+(\alpha\beta)_{ij}+e_{ijk} \tag{3}$$

$$CAR_{ijk}=\mu_{..}+\alpha'_i+\beta'_j+(\alpha'\beta')_{ij}+\Psi X_k+e'_{ijk} \tag{4}$$

where CAR_{ijk} is the cumulative abnormal return for firm k in treatment ij; $\mu_{..}$ is the overall mean CAR; α_i is the earnings yield treatment effect; β_j is the sign of unexpected earnings treatment effect; e_{ijk} is experimental error; X_k is the beginning-of-period share price, and Ψ is the share price covariate slope coefficient.

The sample firms were assigned to treatments as follows. Within each year the firms were ranked according to earnings yield and assigned to quintiles. The data were then pooled across years, so that the total number of cases is 2,064 (516 firms × four years) and each quintile contains approximately 413 cases. Similar analyses were performed upon data for the individual years, with no important differences in results, so that only the pooled data results are reported. Results of the analyses of covariance are reported in Table 4 (without the share price covariate) and Table 5 (with the share price covariate).

Table 4 shows that earnings yield is related to the association between earnings news and security returns in a manner consistent with Basu's hypothesis of biased investor earnings expectations. For example, firms with low earnings yields (upward-biased earnings expectations) and negative unexpected earnings have the most negative abnormal returns, while firms with high earnings yields (downward-biased earnings expectations) and positive unexpected earnings have the most positive abnormal returns. Although the results

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[3] Collins, Rozeff, and Salatka [1982] report an average cross-correlation of 0.067 among weekly residuals in the estimation period. In this study the average cross-sectional correlation was 0.020. The frequency distribution of cross-sectional correlations was virtually identical in each of the four estimation periods. It was not possible to reject the null hypothesis that the residuals were completely linearly independent at a probability value below 0.90.

TABLE 4

CUMULATIVE ABNORMAL RETURN ACROSS EARNINGS YIELD QUINTILES AND UNEXPECTED EARNINGS: WITHOUT PRICE COVARIATE (EQUATION 3)

	Adjusted Cell Means						*Analysis of Variance*		
	Earnings Yield Quintile								
Sign of Unexpected Earnings	*1*	*2*	*3*	*4*	*5*	*Mean*	*Source*	F-*statistic*	(p)
Negative	−.060	−.059	−.066	−.010	−.008	−.041	Unexpected Earnings	148.7	(.000)
Positive	.069	.063	.079	.090	.101	.080	Earnings Yield	3.7	(.004)
							Interaction	.6	(.660)
Mean:	.001	−.003	−.009	.033	.045				

in Table 4 do not reflect the classification bias in Basu's market index earnings expectations model, they still support his statistical conclusions at conventional levels of statistical significance. Table 5, however, shows that when share price is included as a covariate, the earnings yield effect is no longer statistically significant. This indicates that earnings yield proxied for the share price effect and offers no support for the view that disparate price earnings ratios reflect biased investor expectations of earnings.[4]

IV. CONCLUDING COMMENTS

This paper re-examines Basu's [1978] finding that earnings yields affect the unexpected earnings-security returns association in a manner consistent with biased investor expectations of earnings. Results indicate that those findings were due to (1) a classification bias inherent in the mechanical earnings expectation model used, and (2) the failure of the returns conditioning model to incorporate a share price effect upon security returns.

Although the paper focused upon Basu's [1978] study, two main implications apply to contemporary accounting research. It demonstrates that in addition to being relatively less efficient than financial analysts' forecasts, the market index model provides downward-biased measures of earnings expectations for low earnings-yield firms, and upward-biased measures of earnings expectations for high earnings-yield firms. Accordingly, a comparison of portfolios of firms on the basis of forecast accuracy, or upon the degree of association between unexpected earnings numbers and security returns, would be confounded to the extent that the earnings yields are not equal across portfolios.

The second implication is the need to control for the still unexplained association between share price and abnormal security returns. The research upon which this paper is based indicates that share price has a stronger cross-sectional association with security returns than does systematic risk, and consequently must be controlled for in comparisons of returns across firms or portfolios. Moreover, the fact that share price appears to be "priced" in securities markets has implications for the interpretation of

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[4] When the analysis is reversed so that earnings yield is used as a covariate, and the treatments are defined as share price quintiles and unexpected earnings, the share price effect continues to be significant (*F*-value above 30, probability value below .0001).

TABLE 5
CUMULATIVE ABNORMAL RETURN ACROSS EARNINGS YIELD QUINTILES AND UNEXPECTED EARNINGS: WITH PRICE COVARIATE
(EQUATION 4)

	Adjusted Cell Means								
	Earnings Yield Quintile						*Analysis of Variance*		
Sign of Unexpected Earnings	*1*	*2*	*3*	*4*	*5*	*Mean*	*Source*	F-*statistic*	(p)
Negative	−.049	−.049	−.064	−.021	−.020	−.041	Unexpected Earnings	160.1	(.000)
Positive	.078	.071	.081	.085	.085	.080	Earnings Yield	1.2	(.309)
Mean:	.011	.006	−.006	.026	.031		Interaction	.6	(.670)
							Price Covariate	158.1	(.000)

associations between abnormal returns and accounting variables deflated by share price. In such studies, unless the returns conditioning model incorporates the effect of share price, the numerator and denominator of the price-deflated accounting variables may have contrary implications for security valuation. Accordingly, failure to control for the share-price effect in empirical studies concerned with the association between accounting variables and security returns may either obscure or overstate the underlying relations.

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The Effects of Setting Budget Goals and Task Uncertainty on Performance: A Theoretical Analysis

Mark K. Hirst

ABSTRACT: This paper discusses the effects of setting budget goals on task performance in different task situations. The main hypothesis developed from this analysis is that the effect of setting specific, difficult budget goals on task performance depends on the level of task uncertainty. Specifically, it is argued that, where task uncertainty is high, setting budget goals is less effective in promoting task performance than where task uncertainty is low. In addition, it is suggested that, although limited, available evidence is consistent with this hypothesis. Finally, the research implications of the analysis are considered.

BUDGET goals are often used as a means for affecting motivation, behavior, and task performance. These effects can be positive or negative depending on the characteristics of budget goals (e.g., Lowe and Shaw [1968]; Hopwood [1972]). Two characteristics that have received attention in the accounting literature are the specificity and difficulty level of budget goals. Specific budget goals are those that are expressed in quantitative terms (such as "sell x units of product y"), whereas non-specific or general goals are expressed in non-quantitative terms (such as "sell as many units of product y as possible") [see Baumler, 1972]. In contrast, goal difficulty refers to the level of performance required to achieve a goal. In general, goals are moderately difficult where they are set at the average level of performance for a given task. Goals established at levels above (below) average are labelled difficult or high (easy or low) [see Chow, 1983]. Typically, results show that setting specific, difficult budget goals (hereafter referred to as *goal setting*) leads to higher task performance than setting either specific moderate goals, specific easy goals, or general goals (e.g., Stedry and Kay [1966]; Hofstede [1968]; Rockness [1977]; Chow [1983].[1]

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[1] There are two ways goal setting has been operationalized in the literature. First, as a continuous variable, by manipulating the difficulty level of goals (e.g., Chow [1983]). Under this approach, all budget goals are specific (i.e., expressed in quantitative terms). In essence,

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These results are consistent with those reported in the psychology literature (for a review, see Locke et al. [1981]). Indeed, accounting researchers rely on this literature to predict and interpret the effects of setting budget goals (e.g., Ronen and Livingstone [1975]; Kenis [1979]). This reliance appears appropriate for two reasons. First, the types of goals in focus are similar across both literatures.[2] And second, Locke et al. [1981] claim that the beneficial effect of setting specific, difficult goals on task performance is one of the most robust and replicable findings in the psychology literature.

Nevertheless, some caution is required in relying too heavily on the psychology literature. In a recent critique of that literature, Naylor and Ilgen [1984] suggest that surprisingly little attention has been paid to examining the process by which goal setting promotes performance. This lack of interest extends beyond an examination of why goal setting works, to include an examination of moderator variables that can limit the extent to which goal setting has a positive effect on performance.

An examination of moderator variables is particularly important for two reasons. First, it has the potential to delineate situations in which goal setting does *not* have a positive effect on performance. This is significant because it suggests a need to control for moderator variables in future studies that empirically investigate both the direct effects of goal setting on performance, and the way goal setting combines with other factors (e.g., participation) to affect performance. Second, knowledge about moderator variables can have practical implications. In particular, the designers of goal setting programs can use such knowledge to anticipate the effects of their programs, and to introduce goal setting interventions in only those situations where they are expected to have a positive effect on performance.

The purpose of this paper is to develop theoretically the effect of a potential moderator variable, task uncertainty, on the relation between goal setting and performance. A brief review of the explanations for goal setting effects is necessary before providing both the theoretical rationale and supporting evidence for the moderating effects of task uncertainty.

I. THE RELATION BETWEEN GOAL SETTING AND TASK PERFORMANCE

The relation between goal setting and performance can be described with the aid of Figure 1, which shows the hypothesized sequence of activities that connect goal-related stimuli with task performance. Similar models of task performance are provided by Locke [1968] and Porter et al. [1975]. Figure 1 shows that goal-related stimuli are followed by a set

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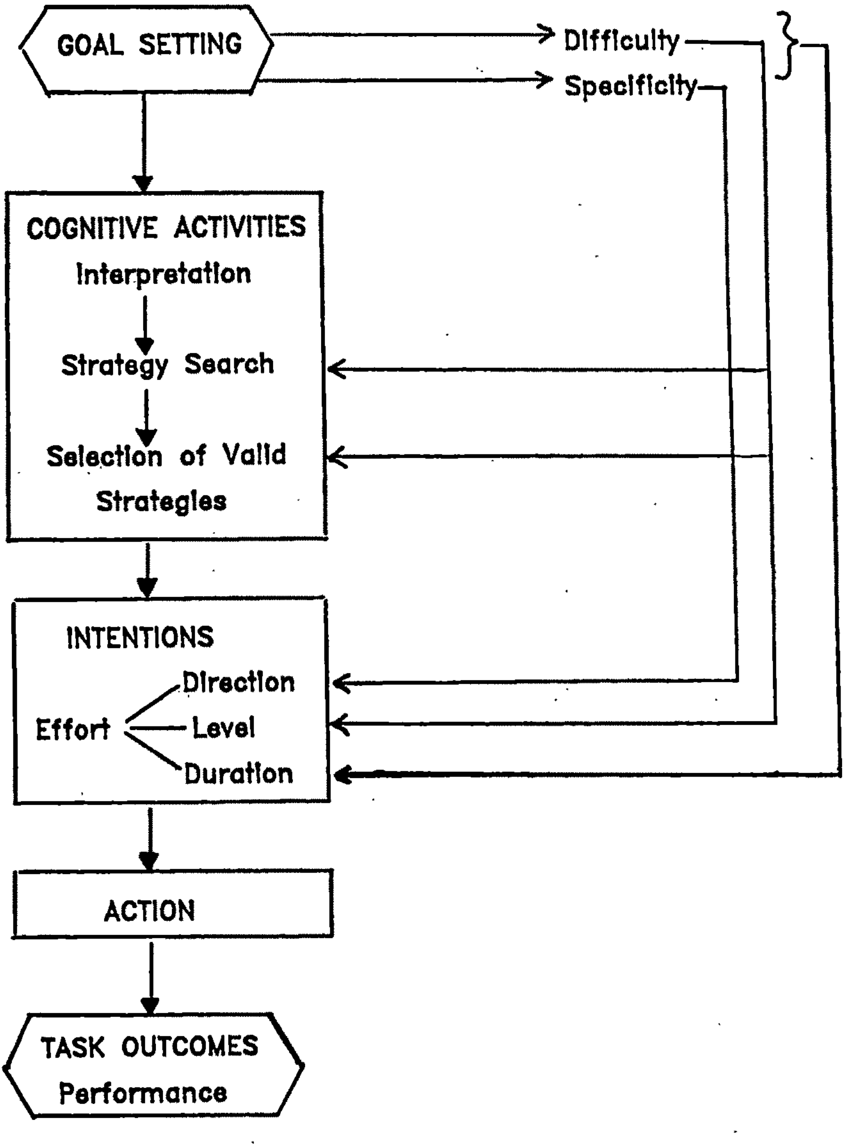
goal specificity is not manipulated. The second approach involves operationalizing goal setting as a dichotomous variable (e.g., Baumler [1972]). This is achieved by establishing, on the one hand, a general goal (such as "do your best") and on the other hand, a specific, difficult goal. Both approaches assume that there is commitment to (i.e., acceptance of) the goals.

[2] Studies in psychology have investigated the effects of setting specific, difficult goals across a variety of tasks (for a review see Locke et al. [1981]). Typically, goals are established in relation to some physical measure of productivity on these tasks. Consequently, it might be claimed that a potential difference between studies in the accounting and psychological literatures is that the former tend to focus on financial (budget) goals, whereas the latter tend to focus on non-financial, physical goals. However, a review of the literatures reveals studies in the accounting literature that use non-financial, quantitative goals [e.g., Rockness, 1977; Chow, 1983] and studies in the psychology literature that use budget goals [e.g., Ivancevich, 1977; Ivancevich and McMahon, 1977; Campbell, 1984; Chesney, 1985; Campbell and Gingrich, 1986]. This common ground between the literatures is extended further when it is recognized that budget goals can be expressed in both physical and financial terms (see Horngren [1982]).

FIGURE 1
THE RELATION BETWEEN GOAL SETTING AND TASK PERFORMANCE



of cognitive activities. This set involves the interpretation of goals, search for valid plans or strategies, and selection of valid plans to guide action. Valid plans include only *relevant* activities, that is, activities necessary and sufficient to achieve a specific level of task performance. Figure 1 also shows that the cognitive activities lead to the formation of intentions to act. These intentions include a concern for effort required during task performance. As discussed below, direction, level, and duration are the dimensions of effort expenditure that are important in explaining goal-setting effects [Locke et al., 1981]. Finally, Figure 1 shows that action follows the intention formation process; and one outcome of action is task performance.

An elaboration of the link between goal setting and performance is provided by Locke et al. [1981], who suggest four mechanisms by which goal setting has a positive effect on performance. Three of these mechanisms have a direct or immediate effect on performance. In particular, Locke et al. suggest that goal setting has a beneficial impact on the direction, level, and duration of effort. Recall that goal setting involves establishing specific, difficult goals. Locke et al. claim that acceptance of specific goals focuses attention on relevant activities. Consequently, goal setting *directs* effort to accomplish these activities. Also, they claim that more difficult goals (if accepted) translate directly into a greater *level* of effort in accomplishing relevant activities. In addition, they claim that acceptance of specific, difficult goals ensures that individuals will continue effort over time (*duration*) in an attempt to attain goals. The fourth mechanism for explaining goal effects focuses on two of the cognitive activities shown in Figure 1. Specifically, Locke et al. claim that goal setting can indirectly focus effort by stimulating individuals to develop effective strategies or plans for attaining goals. Naylor and Ilgen [1984] suggest that strategy development involves both the search for, and selection of, valid strategies. Goals are assumed to trigger these cognitive activities.

Note that the above four mechanisms assume that individuals know what actions are necessary for goal achievement. In terms of Figure 1, the four mechanisms are conditional on the accurate interpretation of goals and the effective search for, and selection of, valid action plans. The aim of the following section is to argue that difficulties arise in performing these cognitive activities where task uncertainty is high. As a consequence, it is hypothesized that task uncertainty moderates the relation between goal setting and task performance.

II. Task Uncertainty and the Relation Between Goal Setting and Task Performance

There are two propositions that are central to the argument about the moderating effects of task uncertainty. First, task uncertainty has a negative effect on the completeness of task knowledge. Second, the positive effects of goal setting are conditional on the completeness of task knowledge. The relations contained in the two propositions are shown in Figure 2, and each proposition is discussed in turn below.

Task Uncertainty and Task Knowledge

Following Hirst [1981], task uncertainty is defined in terms of repetitiveness and openness. Repetitiveness refers to the frequency with which the focal task is performed, and openness refers, in organizational settings, to the extent to which a task is affected by events or stimuli external to the focal organization and to tasks performed by others in the focal organization.[3] Tasks that are both non-repetitive (repetitive) *and* open (closed) to "significant" outside influence are referred to as high (low) uncertainty tasks.[4]

As uncertainty varies across tasks, it is likely that the completeness of task

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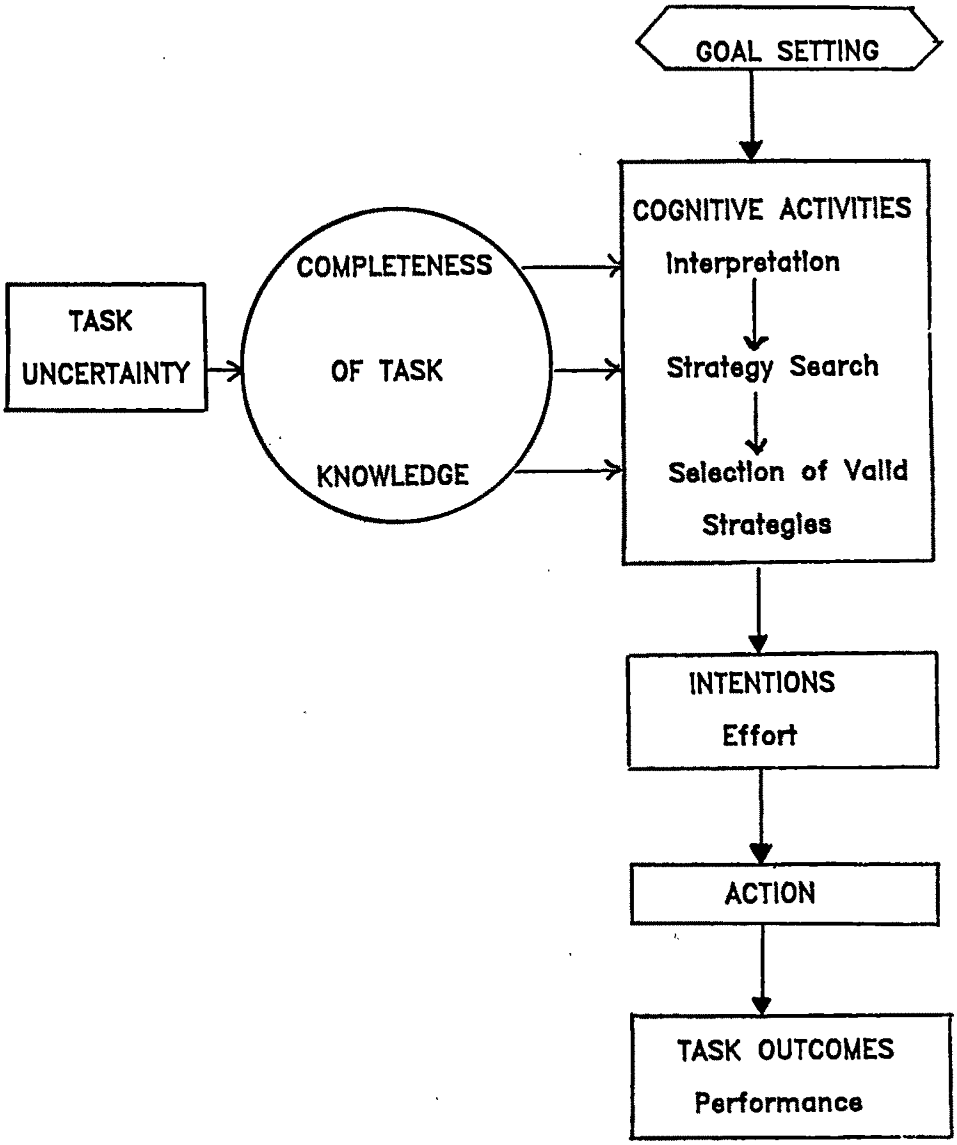
[3] Thompson [1967, Chs. 5, 6] refers to the dimensions underlying task openness as the degree of "environmental" uncertainty and the complexity of "task interdependencies."

[4] As with other multidimensional constructs (e.g., see Wood [1986] on task complexity), difficulties arise in specifying the relations between the components of task uncertainty and total task uncertainty. At this point it is only claimed that other things being equal, repetitiveness reduces uncertainty and openness promotes uncertainty.

FIGURE 2
THE EFFECTS OF TASK UNCERTAINTY ON THE RELATION BETWEEN GOAL SETTING AND TASK PERFORMANCE



knowledge[5] will also vary. Both dimensions of task uncertainty, repetitiveness and openness, have implications for the acquisition and, therefore, the completeness of task knowledge. In particular, repetitive (low-uncertainty) tasks provide more opportunities than non-repetitive (high-uncertainty) tasks for developing task knowledge. And although the opportunity to develop task knowledge is not tantamount to the acquisition of knowledge, there is likely to be a positive relation between these variables. If so, then there is likely to be a positive (negative) relation between task repetitiveness and the completeness of task knowledge.

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[5] Task knowledge refers to knowledge about the components of a task, the activities and outcomes, the relations (e.g., spatial, temporal, cause-effect) among activities and outcomes, as well as knowledge about other factors (e.g., standard props, typical rewards associated with successfully completing the task).

Further, as tasks become more open, the actions of others will influence achievement levels on task outcomes. However, modeling this influence is difficult (and, at the limit, not possible) because the actions of others are often unobservable and/or unknown. The inability to model the influence of others causes knowledge about the consequences of "own" actions to be problematic. In addition, modeling the task is made difficult in these situations because some of the consequences of own actions are unobservable and/or unknown [Merton, 1936; March and Olsen, 1976]. As the inability to model a task constrains the acquisition of task knowledge, there is likely to be a negative relation between task openness and the completeness of task knowledge.

If the above analysis is accepted, then it is likely that a negative relation exists between task uncertainty and task knowledge. This relation is important because, as argued below, the positive effects of goal setting are likely to be conditional on the completeness of task knowledge.

Task Knowledge and Goal-Setting Effects

Recall from Figure 2 that there are three cognitive activities (i.e., goal interpretation, strategy search, and selection) that need to be performed if goal setting is to have a positive effect on task performance. The completeness of task knowledge can affect all three activities. To illustrate, consider your reaction to the following goal-related instructions: "Perform two CATscans on Tuesday morning," or "Assemble 200 carburetors each week." For some, the first instruction is not interpretable because we have no knowledge of what the label "CATscan" represents. And although many of us can interpret the second instruction at a general level, it is likely that some will be unable to develop (search and select) plans to guide actions because of incomplete knowledge about the component activities.

Even though these illustrations are extreme, they do highlight the importance of task knowledge if goal setting is to promote performance. In a more likely situation, goal instructions are communicated to individuals who have some, although less than complete, task knowledge. In some instances, invalid action plans will be developed. Such plans include irrelevant acts and/or failure to include relevant acts for a given task. In either case, even if goal setting causes an increase in the level of effort expended in task performance, such an increase in effort will not have a full impact on performance. In essence, some of this increase in effort will be misdirected, being expended on irrelevant acts. In this case, and in comparison with situations involving valid action plans (i.e., situations involving complete task knowledge), goal setting will have a less positive effect on task performance. And as illustrated above, at the limit, incomplete task knowledge can preclude goal setting from having any effect on task performance.

Indeed, given incomplete task knowledge, goal setting can have a negative effect on performance. Recall that goal setting focuses attention on certain task activities. In particular, goal specificity makes behavior selective. However, selective behavior can be functional and dysfunctional. Functional selective behavior occurs where there is a reduction in the resources spent on performing irrelevant and presumably non-productive activities. Dysfunctional selective behavior occurs where goal setting causes the exclusion of previously performed, relevant activities [e.g., Stedry and Kay, 1966; Locke and Bryan, 1969; Porter et al., 1975]. This overly narrow definition of a task can occur in organizational settings where specific, subunit goals are established for interdependent subunits. Both Baumler [1972] and Hopwood [1972] provide evidence which shows that under these circumstances, *subunit* goals tend to focus the managers' attention on *subunit* activities, relative to those activities which are related to managing the *interdependence* between subunits. Incomplete task knowledge in conjunction with goal specificity can create the false belief that attending to the latter activities is irrelevant and, as such, does not promote subunit performance. In these circumstances, Baumler [1972] shows that, depending on the importance of the excluded activities, goal setting can have a negative effect on subunit performance.

In summary, the previous analysis suggests that the positive effects of goal setting are conditional on the completeness of task knowledge. As task knowledge becomes less than complete, individuals are less likely to be able to effectively undertake the necessary cognitive activities that intervene between goal setting and performance.

Task Uncertainty as a Moderator Variable: The Evidence

Given that goal-setting effects are conditional on the completeness of task knowledge which, in turn, is dependent on task uncertainty, it follows that task uncertainty will moderate the relation between goal setting and performance. This conclusion is formally stated in the following hypothesis.

H1: There is an interaction between goal setting and task uncertainty affecting task performance.[6]

The prior analysis suggests the form of this interaction. Specifically, where task uncertainty is low, goal setting will cause an increase in performance. In contrast, where task uncertainty is high, goal setting will cause either a smaller increase, or no increase, or a reduction in performance.

Assessing the extent to which evidence supports H1 is problematic because few goal-setting studies have been concerned with task effects. Nevertheless, the Rockness [1977] and Chow [1983] results can be interpreted as providing partial support for H1. Recall that in both studies goal setting had a positive effect on performance. Also both studies used the same, repetitive, decoding task. In addition, subjects were given a complete set of instructions for performing the task, and a practice period prior to the experimental sessions. Taken together, these characteristics suggest that task knowledge was relatively complete in both studies. Given the previous analysis, it follows that the task in these studies probably involved low uncertainty. If so, then the Rockness and Chow results are consistent with the arguments, supporting H1, which refer to situations involving low uncertainty.

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[6] Given less than complete task knowledge, it is likely that the meaning of task performance will be unclear where task uncertainty is high [Thompson, 1967, p. 95]. However, here it is intended that task performance refers to actual achievement levels on the task outcome(s) captured by the budget goal(s)

Specifically, goal setting has a beneficial effect on performance where task uncertainty is low.[7]

There are few studies that examine goal-setting effects where task uncertainty is high.[8] An exception is Baumler [1972], who used a resource allocation task to investigate the effect of goal specificity and the complexity of task interdependence ("pooled" versus "reciprocal"; see Thompson [1967]) on task performance. Consistent with H1, he found that performance on the task involving pooled (reciprocal) interdependence, a characteristic indicative of low (high) task uncertainty, was higher for the specific (general) goal condition. Baumler claimed, and provided supporting evidence, that setting specific output goals for the reciprocally interdependent task caused subjects to focus on their own task goals and, as a consequence, reduced the communication (activity) between subjects. He claimed that such communication was necessary for high task performance on this task. Thus, consistent with previous arguments, Baumler's results showed that where task uncertainty is high, goal setting can cause a deterioration in performance if invalid action plans are developed.

However, Baumler [1972] did not report on the difficulty level of goals. Consequently, the assigned, specific goals might have been set at low levels or high and unacceptable levels. If so, then the lower performance on the reciprocally interdependent task can be explained by either insufficient challenge or goal rejection.[9] In either case, Baumler's experiment would not test H1. Moreover, Baumler [1969] did not attempt to provide a specific description of how task design provided the potential for goals to promote performance. Accordingly, for the reciprocally interdependent task, it might have been technically impossible for goal setting to promote performance. Finally, there is doubt concerning Baumler's claim that for the reciprocally related task, goals caused a reduction in communication, which in turn caused a deterioration in performance. At issue is the relation between communication and performance. Although Baumler [1969] claimed that they were positively related, he did not attempt to provide a specific description of how this relation was built into the task design. As a consequence of the above concerns, care must be exercised in assessing the extent to which Baumler's results support H1.[10]

In summary, both argument and evidence suggest that task uncertainty will moderate the relation between goal setting and task performance. At this stage, however, evidence about goal-setting effects is limited, particularly where task uncertainty is high.

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[7] More generally, it has been claimed that goal-setting studies in the psychology literature typically involve low uncertainty (e.g., see Frost and Mahoney [1976]; Campbell [1984]). A review of these studies provides additional support for the claimed advantages of goal setting in low uncertainty situations.

[8] In the psychology literature, Frost and Mahoney [1976], using a *non-prescribed* task, and Campbell [1984], using a *complex* task, found that the level of assigned goals had *no* effect on performance. Although consistent with that part of H1 which refers to situations involving high uncertainty, both studies report [1976, p. 342; 1984, pp. 36-37] that the null findings might be due to range restriction on the goal difficulty treatment.

[9] Recall that goal setting requires establishing specific, difficult, yet acceptable goals.

[10] Campbell and Ilgen [1976] manipulated the task in their goal-setting study. They investigated the way in which performance on chess problems was affected by goal difficulty and "task difficulty." Task difficulty was manipulated by varying the number of moves (one to three) needed to achieve checkmate. Although the interaction between goal difficulty and task difficulty was not significant, inspection of the means in Table 1 [1976, p. 322] shows that performance on the easy task increased with goal difficulty; however, performance did not increase on the difficult task. These results are consistent with H1. The lack of significance for the interaction term is probably due to the relatively low performance of subjects who were assigned moderately difficult or difficult tasks.

III. IMPLICATIONS

If the previous analysis is accepted, then an early priority in goal-setting research is to test the moderating effects of task uncertainty. This is particularly important because the design of budgetary control systems involves setting budget goals across tasks that differ both in function (e.g., production, sales, research and development) and organizational level (i.e., individual, subunit, and organizational). As such, budgetary control systems are likely to be applied across settings that involve a considerable diversity in task uncertainty. The early work by Baumler [1972] could provide a starting point for testing the moderating effects of task uncertainty. If so, it would be necessary to address the internal validity threats associated with his study.

More generally, there is a need to examine the wider behavioral and psychological outcomes associated with goal setting.[11] With few exceptions (e.g., Kenis [1979]) previous studies focus on budget performance as the dependent variable of interest. An interest in the wider effects of goal setting is particularly important where there are problems associated with measuring budget performance. Specifically, where task uncertainty is high and rewards are based on budget performance, both the incentive and opportunity exist for falsifying information about actual performance [Lowe and Shaw, 1968; Hirst, 1981]. That is, one of the potential behavioral effects of goal setting (where uncertainty is high) is to reduce the reliability of budget performance measures. Accordingly, there are three reasons for examining the wider behavioral and psychological effects of goal setting. First, focusing on several dependent variables increases our understanding of goal-setting effects. Second, measures of budget performance can be unreliable, particularly where task uncertainty is high. Third, an examination of the behavioral effects (particularly invalid data reporting) can provide some indication of the reliability problems associated with using budget performance measures.

The studies by Baumler [1972] and Mossholder [1980] illustrate how we might examine the wider effects of goal setting in different task situations. Interestingly, results of these studies suggest that (as with budget performance) the wider effects of goal setting might be contingent on task uncertainty.

Finally, there is a need to integrate the present analysis with prior research on the characteristics, use, and impact of budgetary control systems. At a specific level, this could be achieved by examining the way goal setting and task uncertainty interact with other factors (such as budget participation, budget emphasis, feedback, and type of incentive scheme) to affect task outcomes. To illustrate, consider the Hirst [1983] study that showed how the effect of leader style (i.e., budget emphasis in performance evaluation) on job tension depends on task uncertainty. Note that budget emphasis does not indicate the difficulty level of the (specific) budget goals used in performance evaluation. In short, budget emphasis does not imply goal setting.[12] Consequently, it remains to consider whether Hirst's results are affected by goal setting. Given that goal setting

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[11] These outcomes might include the incidence of so-called functional and dysfunctional behavior [Lawler and Rhode, 1976; Galbraith, 1977] and various psychological outcomes (such as job satisfaction and stress, intrinsic motivation, and so on) that have been of interest to researchers.

[12] Nor does goal setting imply the subsequent use of budget goals in evaluating performance.

(particularly goal difficulty) can promote job tension, then it could be argued that, where task uncertainty is high, the positive relation between budget emphasis and job tension (see Hirst [1983]) will be attenuated by a reduction in goal difficulty. In essence, the present analysis could provide a basis for extending the Hirst study by suggesting a three-way interaction among goal setting, budget emphasis, and task uncertainty affecting job tension.

At a more general level, the present study examines how alternatively designed budgetary control systems affect performance. By focusing on task uncertainty, the potential exists for integrating the present analysis with related studies that focus on the relation between task uncertainty and control system design encompassing both social (e.g., leader styles—Hirst [1981]; Govindarajan [1984]) and organizational (e.g., structure—Galbraith [1977]) factors. Initially, integration can be achieved by developing an inventory of outcomes associated with specific design variables in different situations. For example, consider the two design variables, goal setting and the level of budget emphasis in performance evaluation. The present analysis suggests that, where task uncertainty is low, goal setting will promote performance and, following Hirst [1981], the subsequent use of budget goals to evaluate performance (to the exclusion of other performance criteria) will minimize the incidence of dysfunctional behavior such as falsifying accounting information. In contrast, where task uncertainty is high, the beneficial effects of goal setting on performance are less likely to occur and, again following Hirst [1981], subsequent use of budget goals to evaluate performance will promote dysfunctional behavior. The development of such inventories is important because, in conjunction with design criteria, they provide a basis for the effective design of budgetary control systems.

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Pension Obligations and the Bond Credit Market: An Empirical Analysis of Accounting Numbers

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ABSTRACT: The purpose of this study is to examine the importance and measurement of net pension variables in the bond rating decision. This paper uses SFAS No. 36 pension footnote disclosures to develop measures of the net pension asset (liability) to be included as an independent variable in a bond rating prediction model. Multiple measures of the pension obligation (asset) are calculated in an attempt to determine which, if any, of these measures are found to be a significant factor in bond ratings. Measures used include the pension obligation actually reported by the corporation in its annual report as well as recalculated obligations based on cross-sectionally standardized interest discount rates. Results indicate a lack of significance of any pension measure in 1980. In 1981 and 1982, pension measures calculated using standardized interest rates are found to be significant in the bond rating decision. In no year was the coefficient for the pension measure actually disclosed by the company in its annual report significant. Further analyses on subgroups indicated that the pension variable was highly significant in 1981 and 1982 for net pension liability companies when the obligation was discounted at the average interest rate, but not significant in those years for net pension asset companies.

THE Financial Accounting Standards Board (FASB) requires corporations to make public disclosures regarding their defined benefit pension plans [FASB, 1980; FASB, 1985]. At present, measurement of the future pension obligation is determined, in large part, by a company-chosen interest discount rate. An important question for financial reporting concerns users' perception of this future obligation and its measurement.

The empirical analyses presented here provide evidence of whether a pension obligation measure is impounded in bond ratings. The findings are consistent with bond rating analysts' inclusion of a measure of the pension obligation in their financial assessment of a company, and this measure is likely to be computed using standardized interest dis-

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count rates. These results support the idea that bond rating analysts are not being fooled by the use of high interest rates by some companies to minimize the reported pension obligation.

PRIOR RESEARCH

A number of studies [Feldstein and Morck, 1983; Daley, 1984; Landsman, 1986] have examined the use of various pension measures with regard to the equity market value of a firm. Feldstein and Morck [1983] determined that unfunded pension liabilities evaluated at a common average interest rate generally have better explanatory power than the corresponding reported pension liabilities. Daley [1984] discovered that the tax-adjusted pension expense variable was the best available measure of impounding future pension costs. Landsman [1986] reported that the full value of pension assets and liabilities lies completely with the firm and is valued by the equity security markets as corporate assets and liabilities. Dhaliwal [1986] determined that the effect of unfunded vested pension liabilities on market-perceived risk of the firm was not significantly different from that of debt.

Nichols and Morris [1982] examined the corporate defined-benefit pension obligation for evidence of interest rate grouping within industry. Results failed to indicate any uniform grouping pattern. Morris, Nichols, and Niehaus [1983] reported that managers explicitly consider the extent of a plan's overfunding or underfunding when deciding by how much to increase the interest rate assumption for the reported pension obligation. By including average levels of salary progression in the pension obligation, Morris and Nichols [1984] determined that putting a net pension variable on the balance sheet of corporations would produce a significant change in their debt ratios. Rue and Volkan [1984] discovered that including a net pension variable on the balance sheet would produce a significant change in the return-on-assets ratio.

A separate area of investigation has been concerned with bond rating models. Research in this area [Fisher, 1959; Horrigan, 1966; Pinches and Mingo, 1973, 1975; Kaplan and Urwitz, 1979] has produced models with classification accuracies ranging from 50 percent to 75 percent. The linkage between pension variables and bond ratings was examined by Martin and Henderson [1983], who utilized various measures of a firm's pension liability in an attempt to increase the predictive accuracy of bond ratings. They concluded that the pension variables tested were important.

The present study focuses on the relation between pension variables and bond ratings to examine the measurement and significance of corporate pension variables. This study differs significantly from the Martin and Henderson work in the following ways. Specifically, it: (1) uses a previously developed, successful "benchmark" model from which to compare an extended model; (2) uses SFAS No. 36 pension measures that are based on a consistent actuarial cost method across firms;[1] (3) uses a standardization of the interest rate assumption to calculate the present value of accumulated pension benefits; (4) determines which individual pension measures are significant; and (5) examines the potential differential significance of pension information for net pension asset companies versus net pension liability companies.

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[1] The SFAS No. 36 pension disclosures used in this analysis are all based on the same actuarial cost method (unit credit). A number of previous studies were forced to use pension measures calculated based on numerous actuarial cost methods.

METHOD

To determine the measurement and significance of the corporate pension obligation in the bond rating process, the Kaplan and Urwitz [1979] model was chosen as a benchmark from which to build an extended model. The Kaplan and Urwitz model has been found to be successful while using a minimum number of variables.[2] The model explains bond ratings as a function of five independent variables:

$$\begin{aligned} BOND = B_0 + B_1\,DEBT + B_2\,ASSETS \\ + B_3\,SUBORD + B_4\,BETA \\ + B_5\,INCOME \end{aligned} \tag{1}$$

where *BOND* is the bond rating (increasing values indicate higher risk), *DEBT* is long term debt/total assets, *ASSETS* is total assets, *SUBORD* is subordination status, *BETA* is the common stock market beta and *INCOME* is net income/total assets.[3]

This five-variable model is used as a benchmark from which to compare the results of a six-variable model which includes a variable representing the net pension obligation position of the firm. The emphasis of this analysis is on the following hypotheses: Is any measure of the net pension obligation variable significant in the bond rating decision process? If so, which one? The hypotheses to be tested take the general form of:

> H_0: The coefficient of the net pension obligation variable ≤ 0.

Since it is not known which measure of the pension obligation (if any) is used in the bond rating process, several measures are tested. These include the pension obligation actually reported by the individual corporation in the annual report as well as obligations recalculated based on standardized interest rates to discount the future pension obligation to the present. A positive significant coefficient is consistent with the hypothesis that the pension measure is considered relevant and important by bond rating analysts.

In addition, two groups are formed from the sample based on the sign of the net pension variable when the obligation is discounted at the average interest rate used by all companies in the sample for a particular year. The general null hypothesis is tested separately for each group to determine whether pension information is treated by bond rating analysts with the same significance for net pension asset companies as it is for net pension liability companies.

VARIABLES AND SAMPLE

Variables

The bond rating and subordination status for each company in the sample were obtained from the December year-end edition of the Standard & Poor's (S&P) Corporation Bond Guide [December 1980, 1981, and 1982]. A firm with the highest S&P bond rating (AAA) was coded one (low risk), a firm with an AA rating was coded two (higher risk), etc.[4] A nonsubordinated bond was coded zero (lower risk), while a subordinated debenture was coded one (higher risk).

To be included in the sample, an in-

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[2] The basic Kaplan and Urwitz model successfully predicted the ratings of 66 percent of a holdout sample of new issues of debt. All the ratios included in that study were five-year averages. Since five years of pension data were not available to conduct this study, all the financial ratios used are single-year amounts. Since the primary intention of the analysis is for hypothesis testing of the added pension variable, this should not critically hinder the appropriateness of the basic model as a testing vehicle.

[3] The income variable is net income after extraordinary items and discontinued operations. The analyses were also run using an operating income measure. The basic findings for all three years were consistent.

[4] The last two rating groups in this sample (B and CCC) were combined and coded six because of the small number of observations in the CCC category.

TABLE 1
SAMPLE CHARACTERISTICS

(A) Sample Compilation Summary

		1980	*1981*	*1982*
Firms on SFAS No. 36 Tape		1348	1348	1348
less:	Non industrial firms	787	787	787
	Firms with missing pension variables	121	48	67
	Firms without S&P Bond Rating	251	316	293
	Firms with missing *Value Line* variables	20	1	6
	Firms with missing COMPUSTAT variables	0	0	7
	Firms in sample	169	196	188
add:	Duplicate data points	13	16	12
	Total sample size	182	212	200

(B) Bond Rating Category

Bond Rating	*Bond Code*	*1980*	*1981*	*1982*
AAA	1	12	11	12
AA	2	39	46	44
A	3	84	93	74
BBB	4	30	38	45
BB	5	9	7	11
B and CCC	6	8	17	14
Total		182	212	200

(C) Sample Means

	1980	*1981*	*1982*
Total Assets ($ Millions)	4,210	4,290	4,541
Net Income ($ Millions)	264	262	161
Vested pension obligation/total assets	.1627	.1580	.1627
Pension assets/vested pension obligation	1.01	1.04	1.12
Interest discount rate	.0738	.0781	.0822

dustrial firm must have had the required pension data available for at least one of the three years studied (1980, 1981, 1982) along with an unsecured bond issue outstanding during December of that particular year. In addition, the firm was required to have the necessary data available on the *Value Line* and COMPUSTAT files. Each firm's common stock market beta was obtained from the *Value Line* file.[5] Data for the other four independent variables in the basic model were obtained from the Industrial COMPUSTAT file. Relevant statistics describing the compilation and makeup of

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[5] The *Value Line* beta is adjusted for the tendency to converge toward the mean beta of all companies.

TABLE 2
PENSION OBLIGATION VARIABLE DEFINITIONS

ASSETS	total assets
AVB	accumulated vested pension benefits
ANB	accumulated nonvested pension benefits
AAB	market value of assets available to pay pension benefits
VEST	$(AVB-AAB)/ASSETS$
NONVEST	$((AVB+ANB)-AAB)/ASSETS$
VESTAVG	(AVB discounted at average interest rate for year $-AAB)/ASSETS$
NONVESTAVG	(($AVB+ANB$ discounted at average interest rate for year) $-AAB)/ASSETS$
VEST3	(AVB discounted at three percent interest rate $-AAB)/ASSETS$
NONVEST3	(($AVB+ANB$ discounted at three percent interest rate) $-AAB)/ASSETS$

the final sample are presented in Table 1.[6]

The pension data necessary for this study were obtained from the FASB No. 36 file compiled by the Columbia University Research Center [Columbia Accounting Research Center, 1984]. The four primary variables required to develop the actual pension measures used in the bond rating models were: (1) accumulated vested benefits (*AVB*), (2) accumulated nonvested benefits (*ANB*), (3) current market value of assets available to pay pension benefits (*AAB*), and (4) the interest rate used to discount the future pension obligation to the present for public disclosure purposes (*IRATE*).[7] The current market value of assets available for benefits was subtracted from the reported accumulated vested pension obligation to obtain a net pension asset (liability). This net variable was scaled by total assets of the firm to provide the first net pension variable (*VEST*). The second net pension variable was developed in the same manner except that accumulated nonvested benefits were included with the vested pension obligation (*NONVEST*).

The remaining four pension measures were developed in the same manner while using an interest standardization technique to increase intercompany comparability.[8] *VESTAVG* and *NONVESTAVG* were developed when the pension obligation was recalculated using the simple average interest rate used by all firms in the sample for that particular year (1980=7.38%, 1981=7.81%, 1982=8.22%).[9] *VEST3* and *NONVEST3* were formed after the pension obligation was recalculated with the "real" (three percent) interest rate [Brigham, 1979, p. 118]. Formulas for the six pension obligation measures are summarized in Table 2.

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[6] Included in the samples are a small number of companies with both nonsubordinated and subordinated bonds outstanding. These companies were treated as two observations with a different coded subordination status for each. These duplicate data points represented less than eight percent of the final sample size in each year. The statistical analyses were run both with and without the duplicate data points included. The final results and conclusions were essentially the same.

[7] For the small percentage of firms that have multiple pension plans and use different interest rates for each, *IRATE* represents the upper boundary of the interest rates used for all plans. The companies that use multiple interest rates for discounting purposes must also disclose the lower boundary, which is represented by *IRATEL*.

[8] The adjustment technique for standardization assumes that the reported pension obligation represents the present value of a perpetuity of payments discounted at the actual interest rate disclosed. In 1982 this actual interest rate varied from five percent to 15 percent.

[9] The correlation between a firm's reported net pension asset (liability) and its choice of interest discount rate is potentially relevant to the analysis. However, in no year is the Pearson product-moment correlation coefficient between these variables significant at the .10 level.

Statistical Procedure

The primary statistical analyses in this study use an *N*-chotomous probit model. This model is considered more appropriate than ordinary least squares (OLS) regression because of the ordinal nature of the dependent variable, bond ratings. Unlike OLS regression, the *N*-chotomous probit model allows the dependent variable to be noncontinuous.

The *N*-chotomous probit model generates a series of maximum likelihood estimates whose statistical properties are both known and desirable. For large samples these attributes allow for a statistical test of significance on one or more of the independent variables. The likelihood ratio test for the overall significance of the independent variables has a chi-square distribution, while the significance test for a single independent variable is based on the standard normal distribution.[10]

The possibility of multicollinearity within the independent variables is potentially important, since it could drastically affect interpretation of the individual coefficients. A correlation matrix is not always sufficient to expose this condition since the matrix deals with only bivariate comparisons. To examine this possibility, an eigenvalue analysis was performed on the independent variables in each probit model using the Statistical Analysis System (SAS) routine [SAS Institute, 1985]. The results show that the maximum condition indices never exceeded 20 for any model in any year. These results indicate (see Montgomery and Peck [1982, p. 301]) that multicollinearity is not a problem in the models for any year.

It would be desirable to be able to state conclusively that one particular model (and hence, pension measure) is or is not statistically superior to all other choices based on R^2. However, this is not currently possible when using probit analysis, because it is a non-linear technique. Probit analysis uses a pseudo R^2 that precludes direct comparison of R^2 statistics for alternative non-nested models [Aldrich and Nelson, 1984]. Thus, no direct statistical comparison of the six-variable models can be made based on the pseudo R^2 statistic. Any statistical inference concerning the determination of a "best" pension variable must be made from the increase in the chi-square statistic from the five-variable to the six-variable model.[11]

RESULTS

Probit Analysis

The formal test hypothesis used to determine the significance of the specific pension obligation variable when added to equation (1) is:

H_{01}: Coefficient of the pension obligation variable ≤ 0.

A higher net pension obligation indicates a larger unfunded obligation which, in turn, represents higher firm risk. Higher risk is positively correlated with a higher coded value for the firm's bond rating (e.g., CCC=6). The test is carried out individually for all six pension measures. The significance test is one-sided: rejection of the null occurs if the coefficient is significantly greater than zero. The models and results for 1980 are shown in Table 3.

Table 3 indicates that in all seven

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[10] For details of *N*-chotomous probit analysis, see McKelvey and Zavoina [1975]. For a discussion of the appropriateness of probit analysis to evaluate bond rating models, see Kaplan and Urwitz [1979].

[11] The square root of the increase in the chi-square for the model is equal to the *t*-statistic for the added pension variable.

TABLE 3
RESULTS OF PROBIT ANALYSIS ON 1980 BOND RATING MODELS (*BOND*)

	Kaplan and Urwitz								
Expected Sign		+	+	−	+	−	+		*pseudo-*
Model	*Constant*	*Beta*	*Subord*	*Assets*	*Debt*	*Income*	*Pension*	*Chi*^{2}	R^2
Benchmark	0.57309* (0.901)	1.31401 (2.541)	1.62280 (5.646)	−0.00010 (−5.517)	8.05244 (6.414)	−11.09634 (−4.584)		176.52	.69774
plus									
VEST	0.56150 (0.875)	1.32065 (2.544)	1.61968 (5.619)	−0.00010 (−5.494)	8.05438 (6.414)	−11.04562 (−4.509)	*VEST* 0.28499 (0.147)	176.54	.69790
NONVEST	0.48681 (0.745)	1.35105 (2.591)	1.61492 (5.607)	−0.00010 (−5.491)	8.10543 (6.436)	−10.75886 (−4.297)	*NONVEST* 1.05133 (0.610)	176.89	.69928
VESTAVG	0.56282 (0.885)	1.32402 (2.562)	1.64608 (5.647)	−0.00010 (−5.495)	8.07667 (6.425)	11.36246 (−4.599)	*VESTAVG* −0.90933 (−0.484)	176.75	.69741
NONVESTAVG	0.57403 (0.901)	1.31413 (2.542)	1.62376 (5.596)	−0.00010 (−5.509)	8.05204 (6.413)	−11.11405 (−4.391)	*NONVESTAVG* −0.04084 (−0.024)	176.52	.69769
VEST3	0.45688 (0.694)	1.32766 (2.557)	1.60838 (5.582)	−0.00010 (−5.569)	8.10444 (6.441)	−10.49330 (−4.106)	*VEST3* 0.29342 (0.746)	177.07	.69992
NONVEST3	0.40839 (0.614)	1.33755 (2.571)	1.60841 (5.583)	−0.00010 (−5.588)	8.14545 (6.459)	−10.27783 (−3.976)	*NONVEST3* 0.33447 (0.926)	177.37	.70100

* Coefficient estimate (*t*-statistic)

One sided test: significance at .10 level = 1.282; at .05 level = 1.645; at .01 level = 2.326

TABLE 4

RESULTS OF PROBIT ANALYSIS ON 1981 BOND RATING MODELS (*BOND*)

	Kaplan and Urwitz								
Expected Sign *Model*	*Constant*	+ *Beta*	+ *Subord*	− *Assets*	+ *Debt*	− *Income*	+ *Pension*	*Chi*²	*pseudo-* R²
Benchmark	1.52108* (2.786)	0.97297 (2.135)	0.85797 (4.257)	−0.00009 (−6.227)	8.87386 (7.579)	−18.16177 (−6.787)		209.95	.71125
plus									
VEST	1.51815 (2.777)	0.97344 (2.136)	0.84798 (4.181)	−0.00009 (−6.227)	8.84879 (7.547)	−17.88499 (−6.495)	*VEST* 0.75256 (0.443)	210.14	.71189
NONVEST	1.47075 (2.669)	0.98766 (2.165)	0.83858 (4.124)	−0.00010 (−6.230)	8.88476 (7.580)	−17.61304 (−6.324)	*NONVEST* 1.13525 (0.748)	210.51	.71287
VESTAVG	1.52528 (2.768)	0.98806 (2.184)	0.79721 (3.822)	−0.00010 (−6.448)	8.83405 (7.612)	−16.95856 (−6.128)	*VESTAVG* 3.09473 (2.031)	214.13	.72118
NONVESTAVG	1.40938 (2.545)	1.03415 (2.257)	0.78429 (3.822)	−0.00010 (−6.448)	8.96656 (7.612)	−16.60887 (−5.940)	*NONVESTAVG* 3.08379 (2.252)	215.11	.72360
VEST3	1.14914 (1.993)	1.09837 (2.385)	0.74834 (3.589)	−0.00010 (−6.423)	9.26123 (7.768)	−16.62667 (−5.950)	*VEST3* 0.74727 (2.126)	214.51	.72121
NONVEST3	1.10857 (1.907)	1.11029 (2.407)	0.74886 (3.596)	−0.00010 (−6.428)	9.30947 (7.787)	−16.52810 (−5.894)	*NONVEST3* 0.69155 (2.181)	214.76	.72187

* Coefficient estimate (*t*-statistic)

One sided test: significance at .10 level = 1.282; at .05 level = 1.645; at .01 level = 2.326

cases the five basic variables[12] identified by Kaplan and Urwitz [1979] are significant and have the expected sign. However, even with six different pension measures as an independent variable, in no case does the pension coefficient differ significantly from zero at the .10 level. Equivalently, the chi-square statistics are not changed significantly by the insertion of a net pension variable. The first null hypothesis cannot be rejected and the conclusion reached is that the net pension variable is not significant in the bond rating model in 1980.

The results for the seven *N*-chotomous probit models using the 1981 data set are shown in Table 4. Unlike 1980, four of the six net pension measures are significant in their individual models at the .05 level. All of the significant pension measures used a standardized interest rate for discounting purposes, i.e., three percent rate or the average rate (.0783) for 1981. The published pension measures using the interest rate disclosed by the firm were not significant at the .10 level. These findings allow the rejection of H_{01} for 1981 and support the hypothesis that standardized pension measures are significant when added to the bond rating prediction model if the measures are discounted at three percent or the year's average rate.

The results for 1982 are very similar to 1981 and are presented in Table 5. The pension measures reported using the actual interest rates disclosed by the companies are again not significant at the .10 level. The table also shows that both net pension variables calculated using the three percent interest rate were significant at the .01 level. Only one (*NONVESTAVG*) of the variables calculated using the average interest rate was significant at the .10 level.[13]

Classification Accuracy

Classification accuracy is one useful way to examine an individual variable for its practical, economic significance. To do this, each year's sample was randomly split in half. The first half was used to estimate the probit model while the second (holdout) half was used for prediction. The classification results (Table 6) show that all seven models used in Tables 3, 4, and 5 yield significantly higher prediction proportions than a naive model of classifying, in advance, all observations to the category with the largest number, i.e., bond rating A. The results hold for all three years. However, none of the seven models yield proportions that are significantly different from the others. The pension variables do not significantly increase the bond rating model classification accuracy.

Probit Subgroup Analysis

The full sample for each year was divided into two groups based on whether the value of the net pension obligation developed using the average interest rate (*VESTAVG*) is positive (net pension liability) or negative (net pension asset).[14] The second null hypothesis

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[12] As a variation, all seven different probit models were rerun for each of the three years using the natural log of total assets as a substitute for the raw total assets independent variable. The results are consistent with the primary analysis for each year.

[13] A stepwise logistic regression was carried out as a follow-up to the *N*-chotomous probit analysis. The primary results of the probit were basically confirmed.

[14] This same net asset/liability grouping was performed using the actual pension measures reported by the companies. The analysis indicates that no pension variable is significant for any subgroup in any year, which is consistent with the full sample analysis. There can be no net asset/liability grouping of the sample using the *VEST3* variable since all companies in the sample are in a net pension liability position when the obligation is discounted at the three percent interest rate.

TABLE 5

RESULTS OF PROBIT ANALYSIS ON 1982 BOND RATING MODELS (*BOND*)

	Kaplan and Urwitz								
Expected Sign		+	+	−	+	−	+		
Model	*Constant*	*Beta*	*Subord*	*Assets*	*Debt*	*Income*	*Pension*	*Chi*^{2}	*pseudo-*R^2
Benchmark	1.84671*	−0.26978	1.04139	−0.00009	7.24139	−5.54415		168.59	.64352
	(3.582)	(−0.596)	(4.146)	(−6.302)	(7.027)	(−3.822)			
plus									
VEST	1.84712	0.24690	1.03520	−0.00009	7.20759	−6.14966	*VEST* −1.49120	169.30	.64503
	(3.584)	(−0.545)	(4.146)	(−6.341)	(6.990)	(−3.792)	(−0.839)		
NONVEST	1.85404	−0.26673	1.03977	−0.00009	7.22482	−5.67941	*NONVEST* −0.26464	168.62	.64355
	(3.584)	(−0.589)	(4.160)	(−6.303)	(6.980)	(−3.419)	(−0.167)		
VESTAVG	1.86715	−0.28362	1.04414	−0.00009	7.21215	−4.89358	*VESTAVG* 1.50993	169.50	.64570
	(3.613)	(−0.625)	(4.172)	(−6.324)	(6.990)	(−3.055)	(0.949)		
NONVESTAVG	1.82216	−0.28198	1.04905	−0.00010	7.27472	−4.36566	*NONVESTAVG* 2.19503	170.92	.64930
	(3.520)	(−0.620)	(4.184)	(−6.356)	(7.043)	(−2.660)	(1.517)		
VEST3	1.34900	−0.20782	1.07878	−0.00010	7.74831	−2.21165	*VEST3* 1.16608	176.30	.66156
	(2.444)	(−0.455)	(4.291)	(−6.546)	(7.352)	(−1.183)	(2.744)		
NONVEST3	1.31543	−0.20080	1.08036	−0.00010	7.81014	−2.16158	*NONVEST3* 1.07502	177.06	.66374
	(2.374)	(−0.439)	(4.293)	(−6.553)	(7.386)	(−1.169)	(2.868)		

* Coefficient estimate (*t*-statistic)

One sided test: significance at .10 level = 1.282; at .05 level = 1.645; at .01 level = 2.326

TABLE 6
CLASSIFICATION ACCURACY OF BOND RATING MODELS ON PREDICTION SAMPLES

	1980	*1981*	*1982*
Naive Model—classify all bonds as category *A*.	.46	.44	.37
Bond Rating Models:			
Benchmark (Kaplan and Urwitz)	.54	.52	.47
plus			
VEST	.55	.52	.47
NONVEST	.54	.52	.48
VESTAVG	.56	.53	.47
NONVESTAVG	.55	.53	.47
VEST3	.54	.53	.48
NONVEST3	.54	.53	.48

Note: Comparison tests of proportions (see Perles and Sullivan [1969, Chapter 10]) reveal no significant differences (at the .05 level) among any pairs of the Bond Rating Model's predictions. All were significantly better (at the .05 level) than the naive model.

to be tested was:

H_{02}: Coefficient of $VESTAVG \leq 0$

for $VESTAVG > 0$ and $VESTAVG < 0$. The purpose of this analysis is to determine whether bond rating analysts treat the net pension liability information with a different level of importance than the net pension asset information.

The results of testing H_{02} for each of the groups are shown in Table 7. H_{01} was not rejected for *VESTAVG* for the overall sample in 1980, nor was H_{02} rejected for either group. The results for 1981 and 1982 indicate that the net pension variable is positive and significant in probit models for net pension liability companies, but not for net pension asset companies. This allows a rejection of H_{02} for the net pension liability group but not for the net pension asset group in 1981 and 1982.

CONCLUSIONS

The actual pension numbers required to be disclosed by SFAS No. 36 were not significant in the bond rating process for any of the three years studied. Only when these numbers were adjusted to standardized interest rates were certain measures found to be significantly related to bond ratings.

In 1980 no measure of the pension variable was significant. This is not surprising since the SFAS No. 36 disclosures were required for fiscal year-ends beginning after December 15, 1979. There may not have been time for the pension disclosures to be readily available, nor were there any prior years' data available to estimate the current period amounts.

The results for 1981 and 1982 are similar to each other. The pension variable *NONVEST3* is the most significant in 1982 while it is a close second in 1981. This measure includes vested and nonvested benefits discounted at the three percent interest rate. These results support the idea that the bond rating analysts could see through the use of high interest rates by some companies to

TABLE 7

RESULTS OF PROBIT ANALYSIS ON BOND RATING MODELS WITH SAMPLE DIVIDED BASED ON NET PENSION ASSET (LIABILITY) POSITION OF *VESTAVG* PENSION VARIABLE

			Kaplan and Urwitz								
Expected Sign				+	+	−	+	−	+		
Net Pension Variable	*Year*	N	*Constant*	*Beta*	*Subord*	*Assets*	*Debt*	*Income*	*Pension*	*Chi*^{2}	*pseudo-* R^2
Pension Liability	1980	78	1.37572* (1.319)	0.61382 (0.772)	1.41440 (3.207)	−0.00021 (−3.895)	9.85403 (4.813)	−4.87223 (−1.465)	3.46079 (1.151)	79.71	.74353
Pension Asset	1980	104	0.20364 (0.206)	2.34617 (2.862)	2.20006 (5.044)	−0.00007 (−3.413)	6.91341 (4.079)	−20.92152 (−5.144)	−1.34507 (−0.310)	113.91	.73138
Pension Liability	1981	67	2.89601 (2.218)	−0.20947 (−0.236)	1.03919 (2.897)	−0.00011 (−3.476)	10.00410 (4.373)	−16.83895 (−2.801)	6.78751 (1.983)	76.98	.76726
Pension Asset	1981	145	.86658 (1.235)	1.42019 (2.511)	0.70512 (2.598)	−0.00010 (−5.359)	9.40143 (6.268)	−16.12405 (−4.995)	1.80634 (0.568)	139.00	.71615
Pension Liability	1982	48	5.94942 (0.199)	−0.60781 (−0.516)	0.60295 (1.005)	−0.00013 (−2.621)	10.98482 (4.494)	1.69885 (0.612)	18.76704 (2.841)	57.81	.78301
Pension Asset	1982	152	1.85223 (3.020)	−0.02177 (−0.039)	1.14522 (3.932)	−0.00011 (−5.690)	6.39323 (5.172)	−9.81943 (−3.278)	−2.64400 (−0.967)	130.94	.66518

* Coefficient estimate (t-statistic)

One sided test: significance at .10 level = 1.282; at .05 level = 1.645; at .01 level = 2.326

minimize the reported pension obligation.

The overall results do not appear to be driven by the general economy of the sample period. The stock market has historically been a good indicator of this economic activity. In both December 1980 and December 1982 the stock market was in a steady rise. In contrast, the December 1981 stock market was falling. In addition, the findings are apparently not industry-driven. The "smokestack" industries (typically having heavy pension obligations) were excluded and the primary results remained basically unchanged. Finally, there do not appear to be any major provisions of the 1981 tax law changes that should affect this study.

The investigation of including the pension obligation measure in the Kaplan and Urwitz [1979] bond rating model of classification accuracy failed to reveal any significant improvement. This basically indicates a lack of practical, economic value of including pension variables in bond rating models for prediction purposes. However, the individual coefficients in the probit model indicated that a pension obligation that included vested and nonvested benefits discounted at a low (three percent) standardized interest rate provided the best single measure in this study.

The subgroup analysis indicated a differential significance of the pension variable for net pension asset companies as compared to net pension liability companies. Economically, this suggests that the net pension liability is considered to be a liability but the net pension asset is not considered to be an asset. The FASB has apparently adopted a somewhat similar philosophy in SFAS No. 87 [1985] by requiring balance sheet recognition of a minimum net pension liability, but no such recognition for net pension assets. This basic position is in direct contrast to recent experience in which numerous companies have withdrawn hundreds of millions of dollars from each of their overfunded pension plans [*Wall Street Journal*, 1984a, 1984b, 1985, 1986].

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EDUCATION RESEARCH

Frank H. Selto, Editor

Accounting Internships and Subsequent Academic Performance: An Empirical Study

W. Robert Knechel and Doug Snowball

ABSTRACT: This study investigates the impact of student internships on subsequent academic performance. The post-internship course performance of students with internship experience was compared to that of a group of noninterns (matched on grade-point average and hours of coursework completed prior to the internship). Average performance across all courses did not differ significantly between the two groups. Analysis of performance in particular subject areas and courses suggests a tendency for interns to focus their efforts on courses most closely related to their chosen career. However, only in auditing coursework (where substantive knowledge gained from their internship experience should be most applicable) was the performance of interns significantly better than that of the noninterns.

SUPERVISED practical experience is an important preparatory step for a variety of careers (such as medicine, law, journalism, and education). The first formal programs providing practical experience to accounting students were established more than 70 years ago. Under such programs, students are awarded degree credit for supervised work performed in an accounting position.[1] Degree credit awarded for accounting internship programs is based on the assumption that the student's education is enhanced by internship experience. However, there is little empirical evidence available to support this assumption. The purpose of this paper is to provide some evidence

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[1] Of the institutions reporting that an internship program was available to students, Schmutte [1986] found that 80 percent offered degree credit for participation.

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concerning potential educational benefits of internship programs. Specifically, it assesses the impact of internship experience on subsequent academic performance.

POTENTIAL EDUCATIONAL BENEFITS OF ACCOUNTING INTERNSHIPS

Because internship experience is rarely a required component of an accounting degree program, the continued popularity and size of internship programs indicate that they are perceived as beneficial to both students and employers. Student participation may be influenced by financial considerations, job search strategies, and overall career evaluation concerns. Employer participation is probably motivated most strongly by recruiting and staffing considerations. These motivating factors mean that the "market approval" of internships does not necessarily indicate that internships provide incremental educational benefits to the student.

The accounting literature has identified a number of potential educational benefits of internships that may justify awarding degree credit. The AAA Committee on Internship Programs [1952] cited such benefits as: (1) exposure to accounting techniques and problems not encountered in a classroom environment, (2) enhanced understanding of the business world, and (3) improved ability to evaluate and assimilate classroom experiences. Increased motivation to master subject material on returning to school also has been cited as a benefit of internships [AAA Committee on Faculty Residency and Internship Programs, 1955]. Lowe [1965] reported that a significant majority of former interns indicated that their participation clarified points of theory that they had previously studied, increased the meaningfulness of some courses, and warranted the granting of credit. Koehler [1974] also concluded that internship programs have educational merit. He asserted that internship programs motivate students to work hard early in their programs (to enhance their chances of being offered internships) and result in improved grades upon returning to school.

INTERNSHIP EFFECTS ON SUBSEQUENT ACADEMIC PERFORMANCE

Internships may affect subsequent academic performance through the motivation and/or knowledge base of students. Students' general motivation (that is, their willingness to exert more effort in their studies) may be enhanced because they are refreshed by their break from classroom routine and are more cognizant of the relationship between their degree studies and later professional success. On the other hand, returning to the classroom may be anticlimactic, especially if the student is close to graduation or if the internship has resolved career or placement uncertainties. Whether the general motivation of students is raised or lowered, moreover, likely will be affected by positive or negative aspects of their particular internship experience.

Regardless of the overall motivational impact upon students, there may be a differential motivational effect across courses taken after the internship. In other words, students may focus their attention and efforts on those courses now perceived to be more important to their chosen area of specialty, with less effort exerted in other areas. If student motivation does become more focused, performance in accounting courses would be expected to be enhanced by their internship experience, possibly at some expense to performance in nonaccounting courses. This differential focusing effect may also extend to specific accounting courses.

In addition to the motivational implications, internship experiences may provide students with an expanded knowledge base that aids performance in related coursework. For example, if students primarily serve as auditing interns, they may find their experiences and new knowledge to be of direct benefit in mastering the material presented in formal auditing courses. Such transferability of knowledge is less likely to apply to other courses, including other accounting courses.

Koehler [1974] examined the academic performance of 226 students who participated in internships. He compared each student's grade-point average at graduation with the grade-point average immediately prior to the internship. Koehler concluded that students tended to improve academically following participation in an internship program. Increases in grade averages, both cumulative and accounting, of the former interns were more common than grade decreases. Unfortunately, the results were not tested for statistical significance, nor did Koehler use a control group of noninterns. The absence of a control group means that the grade improvements cannot safely be attributed to participation in an internship.

The present study represents an extension and expansion of the initial work by Koehler [1974]. Two features of this study are explicitly designed to obtain more meaningful and generalizable results. First, a control group of nonintern students was selected to eliminate competing explanations of changes in academic performance. Second, performance in specific subject areas was considered to provide insight into effects of differential motivations and the differential substantive knowledge provided by internship experiences.

RESEARCH METHOD

This study was conducted at the University of Florida, which has had an active internship program in accounting for more than a decade. A matched-pairs approach was employed to compare the academic performance of former interns with the academic performance of nonintern students possessing comparable academic records. Random assignment of students to treatment (internship participation) and control (nonintern) groups was not possible since students and intern employers jointly determine internship participants. Selection criteria used by accounting firms are such that intern and nonintern groups will probably differ along certain important dimensions. To overcome these problems, a matching procedure was used. The internship group was identified from records kept of intern placement; the control group was formed by identifying a "match" for each member of the internship group. The matching process was based on overall grade-point average (GPA) and seniority in the degree program.

The intern group consisted of 108 students who registered for intern credit during the period Fall 1978 through Spring 1984.[2] All interns were placed with public accounting firms and, almost without exception, performed audit-related duties during their internship.[3]

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[2] This is not an exhaustive list of students gaining internship experience over the period. A significant number of interns chose not to register for internship credit because the hours were not needed for graduation. We also excluded interns who were not officially majoring in accounting (e.g., business majors) or for whom there was no acceptable matching control subject.

[3] The internship program is highly structured. Students must have completed specific accounting courses (introductory, intermediate, and cost) prior to the in-

A matched sample of 108 students was selected for the control group. The matching process employed three criteria. First, the nonintern had to be enrolled in school during the term that the matching intern was completing his or her internship. Second, the grade-point average of the nonintern immediately prior to the internship term had to be within 0.15 of the intern's GPA. Third, there could be no more than 12 hours difference in the total hours completed immediately prior to the internship term by the intern and nonintern.[4] If a suitable matching nonintern could not be identified, the internship student was dropped from the treatment group.[5] A check was made to ensure that no member of the control group participated in an internship at any time prior to graduation. Each nonintern (control) subject was matched to only one intern subject.

The *absolute* mean difference between subjects on the cumulative GPA dimension was .042; the *absolute* mean difference on the completed hours dimension was 4.248 hours. The 108 intern subjects had an overall mean GPA of 3.366 and had completed an average of 112.61 hours prior to commencing their internship. The corresponding measures for the control group were 3.375 (GPA) and 112.25 (hours completed).[6]

Formal academic transcripts were obtained for the 216 students. The hours completed and grades earned between the start of the internship term and graduation from the undergraduate program were gathered for each subject. Accounting courses were examined individually while other courses were classified as either business (non-accounting) or general (nonbusiness).

RESULTS

This section first presents the effects of internship experience upon subsequent overall performance in undergraduate studies. To assess motivational forces underlying performance, we then report results separately for accounting courses, business courses, and nonbusiness courses. Finally, to assess possible effects of substantive knowledge gained from internships, we report performance

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ternship, and must complete at least one of the required accounting courses after the internship term. Students usually plan their program such that they will be left with 12-15 hours (including one or two required accounting courses) of coursework to complete after the internship. Students generally must go out of town to complete their internship. The only course that is taken during the term is the internship itself. Since the internship is graded on a pass/fail basis, the internship term has no effect on GPAs.

[4] The choice of maximum acceptable differences for the GPA (.15) and the completed hours (12) variables was not wholly arbitrary. We sought to minimize differences between matches without precluding matches where the difference was due to a single term's work. Thus, 12 hours was chosen since that is the average course load for a single semester. The GPA cutoff of .15 approximates the maximum GPA change that can occur during a single semester for an accounting senior whose grades are one level lower than normal (based on previous performance).

[5] The matching criterion for GPA was difficult to satisfy since a large proportion of students with high GPAs participate in the internship program. As a result, our final sample included a slightly smaller proportion of students with exceptionally higher GPAs than the total intern population. The matching process obviously produced a nonintern sample with higher GPAs than the total nonintern population. We dropped approximately 16 percent of our original list in arriving at our intern sample of 108. Maximization of the quality of the matches was the only reason interns were dropped from the sample.

[6] The nature of the institution, characteristics of the accounting program, and some specific testing provided reasonable assurances that variables such as student gender, transfer students, part-time study, other work experiences, course loads, and types of courses completed would not underlie the differences observed for intern and nonintern groups. SAT/ACT scores were not available for all students in our sample (especially those in the early years of the study). Aptitude-related differences should be captured in our pre-GPA variable which, in any event, would be more recent than available standardized test scores. With respect to transfer students, GPAs do *not* include transferred grades, and hours completed include transferred credits only up to a maximum of 64 semester hours. Transfer students must complete all required accounting courses at our institution

TABLE 1
SUMMARY STATISTICS FOR GRADE DATA

	Interns			Noninterns		
Variable	N	*Mean*	*S.D.*	N	*Mean*	*S.D.*
Post-internship grades earned in:						
All courses	108	3.179	.511	108	3.198	.662
Business courses	81	3.296	.551	95	3.410	.583
Nonbusiness courses	65	3.537	.525	79	3.639	.442
Accounting courses:						
All	107	3.119	.561	101	3.059	.660
Non-auditing	101	3.065	.576	91	3.100	.684
Tax	36	2.958	.669	49	3.092	.839
Systems	47	3.309	.576	64	3.195	.652
Auditing	74	3.284	.763	83	3.030	.786

results for three individual accounting courses. The dependent variable in all cases related to grades earned in courses taken after the internship term but prior to graduation from the undergraduate program. The analyses are based on analysis of covariance (ANCOVA) models with fixed effects. The following independent variables were included in the final model:

Independent Variables	*Explanation*
INTERN	Primary treatment factor: interns versus noninterns
PREGPA	Grade-point average prior to the internship term (covariate)
PREHRS	Hours completed immediately prior to internship term (covariate)

The covariate variables are used to remove any random variations that may be due to confounding factors, and to increase the power of the test statistics for the effect of interest (i.e., INTERN).

Overall Performance

Overall post-internship performance is summarized in Table 1. Contrary to prior research [Koehler, 1974], it was found that the overall GPA level dropped after the internship term.[7] The decrease in overall GPA was significantly different from zero ($p<.05$) for both the intern and nonintern groups. The GPA earned in post-internship coursework by the internship group (3.179) was lower than that earned by the noninternship group (3.198), but Table 2 shows that the difference was not statistically significant.

Performance By Subject Area

Post-internship performance was analyzed separately by subject area, with

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[7] To determine if our samples were unrepresentative of the general population of accounting students in this respect, we randomly selected an additional 100 students who graduated in 1982, 1983, 1984, or 1985. We found that 64 of the students had lower GPAs at graduation than at one year prior to graduation. Only 36 students saw their GPA increase during their senior year. The average GPA change for the 100 students was −0.037.

TABLE 2
SIGNIFICANCE LEVELS FOR FACTORS IN ANCOVA

Factor	Post-Internship GPA	Course Grades: Accounting	Course Grades: Business	Course Grades: Nonbusiness
Main Effect:				
INTERN	.5572	.4368	.2909	.3232
Covariates:				
PREGPA	.0054	.0001	.0001	.0001
PREHRS	.8793	.0922	.6969	.4347
R^2	.0376	.2718	.2325	.1131

Factor	Non-Auditing Courses	Accounting Course Grades: Auditing	Accounting Course Grades: Systems	Accounting Course Grades: Tax
Main Effect:				
INTERN	.9502	.0126	.1378	.6606
Covariates:				
PREGPA	.0001	.0001	.0001	.0001
PREHRS	.0556	.5854	.3257	.2014
R^2	.2655	.2088	.2031	.3187

courses being classsified as accounting, business, or nonbusiness. The presumption was that students would approach accounting, business, and nonbusiness courses differently depending on the perceived relation between performance in these courses and subsequent career success in accounting. The perceived relation, which should be weakest for nonbusiness courses and strongest for accounting courses, may be magnified or altered by internship experiences. Descriptive statistics for these variables, presented in Table 1, are consistent with our expectations. That is, the post-internship GPAs of interns were higher than GPAs of noninterns for accounting courses (3.119 vs. 3.059), but were lower for business courses (3.296 vs. 3.410), and nonbusiness courses (3.537 vs. 3.639). However, the ANCOVA for these course categories (Table 2) indicated that there were no statistically significant differences between the intern and nonintern groups.

Performance in Individual Accounting Courses

The direction of differences between the performance of interns and noninterns in the various course categories, though not statistically significant, is consistent with the view that internship experiences may lead to more narrowly focused motivations. Alternatively, the differences, at least in accounting, could also be affected by substantive knowledge gained from the internship experience. This second explanation was examined more closely by separately analyzing post-internship performance in three undergraduate accounting courses normally taken during the senior year of study. As Table 1 shows, many students took auditing, systems, and tax after the internship term. Given the content of these courses and the activities that characterize internship experiences, it can be expected that substantive knowledge gained by interns will not be equally applicable to the three courses. Such substantive knowledge would probably be most relevant to auditing and less applicable to other accounting courses, particularly tax.

Tables 1 and 2 present a summary and analysis of performance in specific accounting courses. Performance in nonauditing courses (which includes tax, systems, and a few less frequently taken accounting courses) taken after the internship was slightly higher for noninterns than for interns (3.10 vs. 3.065). Results for the tax course alone also indicate that noninterns performed better than interns (3.092 vs. 2.958). The pattern was reversed in the systems course where interns outperformed noninterns (3.309 vs. 3.195). These differences were not statistically significant, but the direction of these differences is consistent with the view that customary internship experience is more related to systems work (e.g., via audit applications) than tax work.

Results for the undergraduate auditing class, presumably the course most closely related to internship activities, support our predictions about post-internship performance. The auditing grades provided the only clear evidence of superior performance by the intern students. The intern group had a mean auditing grade of 3.284 compared to a mean of only 3.030 for the noninterns. Table 2 indicates that the difference is statistically significant ($p<.0126$).[8] In general, the results for the separate accounting courses are consistent with those for business and nonbusiness courses in the sense that interns performed worst in courses not directly related to internship experience and best in courses where substantive knowledge could be carried over from internship experience.

SUMMARY, CONCLUSIONS, AND LIMITATIONS

Accounting internships have become increasingly popular among both students and accounting firms over the last decade. Results reported in this paper suggest that while internships may help students master the material presented in a narrow set of accounting courses, there are no clear broad-based or synergistic benefits for subsequent academic studies in general.

The specific findings of the study may be summarized as follows:

1. There was no significant difference between interns and noninterns with respect to the overall GPA earned in courses completed after the internship period. Contrary to Koehler [1974], the cumulative GPA of interns (and noninterns) declined significantly after the internship period.

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[8] In some cases, only one member of a matched pair was included in the analysis. These situations arose when one member of the matched pair completed the auditing course prior to the internship term. An alternative analysis for auditing grades was performed on only those pairs of students where *both* the intern and the matching nonintern took the auditing course after the internship term. This additional matching procedure reduced the sample size to 61. The results were virtually identical to those reported in Table 2 and are not included in the paper. A similar analysis was not possible for the tax and systems courses due to insufficient observations.

2. No significant differences between the two groups were found for performance in total nonbusiness, total business, or total accounting courses taken after the internship period. However, the pattern of GPAs earned in these course categories suggests that the relation of courses to the student's chosen career may affect the degree of motivation of intern students in particular.
3. The undergraduate auditing course was the single area in which interns performed significantly better than noninterns. The auditing course is the most directly related to internship experience. The superior performance of the interns could be due to substantive knowledge benefits of internships and/or narrowly focused motivational forces (i.e., the interns are now more interested in this particular topic area).

Though the issue of post-internship performance was examined with greater rigor than in prior studies, this study has limitations that should be recognized and could lead to further research. First, the data pertain to students at a single institution and may not generalize to other institutions. Second, negative motivational effects may be amplified when students are close to graduation (a so-called "senioritis" effect). Since most students in our study were within a semester of graduation upon returning from the internship, there was insufficient variation in our samples to adequately test this factor. Third, other potential motivational effects may not be completely randomized between the intern and nonintern groups and may be confounding the results. For example, intention to enter graduate school may increase some students' motivations at the end of their undergraduate career.[9] Fourth, the matching procedures may cause regression effects. It is unlikely that our results were so affected since we found a significant internship effect for auditing, but no significant effect for other courses. Our use of matching variables as covariates also provides some protection against regression effects.

A final limitation is the confounding of motivational and knowledge-based effects, particularly in the auditing course. We attributed the general decline in GPAs to a general decrease in student motivation, since knowledge-based benefits should *not* lead to a *decrease* in grades. Where interns earn higher post-internship grades than noninterns, however, this could be due either to experience-generated knowledge or narrow motivational effects or both. Isolating these two effects by obtaining direct motivation measures would be a worthy element of future research in this area.

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[9] Our experience indicates that candidates for the bachelor's degree either enter the profession or enter a graduate program at the same institution shortly after receiving the bachelor's degree. We tested to determine if intention to attend graduate school was a significant covariate, since such intentions may motivate a student during the latter stage of the undergraduate career. We defined GRAD as a dummy variable equal to one if the student actually went to graduate school at the University of Florida (or zero otherwise). GRAD is a surrogate measure of student intentions. Since GRAD only includes students who came back to the University of Florida, some unknown measurement error exists in the classification of our subjects as graduate students. We re-performed the ANCOVA analysis with GRAD as a secondary treatment factor. Significant main effects for GRAD were obtained for overall course performance ($p<.0123$), performance in accounting courses ($p<.0196$), and performance in nonauditing courses ($p<.0049$), in all of which students classified as GRAD were superior. There was also evidence of an INTERN × GRAD interaction in the systems course ($p<.0763$) and the tax course ($p<.0492$). We suspect that these interactions may reflect differences in the typical career paths for students interested in the tax or audit area. Specifically, we believe that students interested in the tax area are disproportionately represented in the graduate/nonintern cell while students interested in auditing are disproportionately represented in the nongraduate/intern cell. These results must be carefully interpreted due to the previously noted potential measurement error in GRAD, but may be a source of interesting future research.

The above limitations notwithstanding, this study's findings offer no support for the view that clearcut, synergistic academic benefits accrue to students who participate in internships. The results suggest that the academic benefits of internships are narrowly confined. Moreover, the results imply that there may be negative motivational effects upon returning to school. We recognize that there may be positive educational benefits from internships that we did not address and that are not captured in grades earned in subsequent academic coursework. Nevertheless, arguments extolling the virtues of internship experience should be viewed with caution in light of the evidence presented in this study.

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FINANCIAL REPORTING

M. Edgar Barrett, Editor

Cost Accounting, Process Control, and Product Design: A Case Study of the Hewlett-Packard Personal Office Computer Division

James M. Patell

ABSTRACT: This case study examines in detail the changes that were induced in a modern cost accounting system by the introduction and evolution of Just-In-Time (JIT) manufacturing. It is intended to do more problem finding than problem solving, in the hope of stimulating the formulation of hypotheses for further study. The project initially sought to detect whether Hewlett-Packard's JIT manufacturing experience had spawned new approaches to cost accounting or had uncovered fundamental weaknesses in traditional procedures. The most promising research opportunities to emerge, however, concern the changing relations between cost accounting, product design, process control, and quality assurance.

"Say, Jim, the manufacturing group converted the Touchscreen assembly line to Just-in-Time over the weekend, and I just wanted to make sure that it wouldn't accidentally raise any red flags over here in Accounting." "No sweat, Bill. I'll bet that Debbie can reprogram a few lines of code and you'll never know the difference."

THIS paper provides a relatively comprehensive and detailed picture of a particular situation, in the hope of stimulating the formulation of hypotheses for further study. It is intended to do more problem finding than problem solving. Arguably, it is a case study in the classical sense of that term.[1] The archetypal case begins with a quoted exchange between two pivotal charac-

Many people at the Hewlett-Packard Personal Office Computer Division were both generous and patient in explaining their operation; I am especially grateful to James Luttenbacher and Debbie Wirsing for their con-

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ters, intended both to introduce the central issue of the case and to impart a flavor for the personalities involved. As the dialogue indicates, the changes induced in an established and elaborate cost accounting system by the introduction and evolution of Just-In-Time (JIT)[2] manufacturing were the original focus of this research. The study initially sought to detect whether Hewlett-Packard's JIT manufacturing experience had spawned new approaches to cost accounting or had uncovered fundamental weaknesses in traditional procedures. The most promising research opportunities to emerge, however, lie at the interfaces between cost accounting, process control, and product design.

The opening dialogue is facetious in one regard: a firm does not "go Just-In-Time" overnight. The study site used modern manufacturing processes to produce complex, high-technology products, and both the products and the process underwent a series of frequent and sometimes drastic changes over a three-year production history. Moreover, evolutionary development seems to be an integral feature of JIT manufacturing, in which the reduction of buffer stocks and careful attention to quality control are intended to uncover hidden flaws in the production process. (See, for example, Hall [1983] or Schonberger [1982, 1986].) Finally, changes in the cost accounting systems lagged changes on the shop floor, as the information system was reconfigured to adequately represent the continually evolving production process.

On the other hand, the opening dialogue accurately portrays the interpersonal dynamics and organizational behavior of the main actors. The Hewlett-Packard (HP) personnel who were involved in the adaptations described herein are energetic and resourceful. They seemed genuinely eager to meet the challenge of adapting to Just-In-Time manufacturing. In particular, one might entertain some skepticism when accounting department members use phrases like, "we need to turn off the paperwork and reduce the infrastructure," but it is easier to envision a group working to reduce its own size in a firm that had maintained a reputation of keeping its personnel in the family and gainfully employed in the face of severe business fluctuations.[3]

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tributions to this study. Helpful comments were received from J. Michael Harrison, Alison Kirby, Katherine Schipper, G. Peter Wilson, Mark Wolfson, and two anonymous reviewers. Special thanks are due M. Edgar Barrett for his extensive help in revising and editing the manuscript.

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This paper is being published simultaneously with the collection of field study results noted above, in exception to THE ACCOUNTING REVIEW's prior publication policy, in the hope that such publication will encourage further "small sample studies" of internal-to-the-firm financial reporting.

[1] Yin [1984, p. 23] defines a case study as "an empirical inquiry that investigates a contemporary phenomenon within its real-life context when the boundaries between phenomenon and context are not clearly evident and in which multiple sources of evidence are used."

[2] A glossary of terms covering the various specialized names and acronyms employed in this study is included at the end of this paper.

[3] During the period of this study, HP used extended vacations, unpaid days off, management pay reductions, and voluntary early retirement programs to manage workforce costs in periods of reduced product demand. However, in June 1986, HP still could state that the firm "never laid off an employee in its history" [*Wall Street Journal*, June 13, 1986].

COMPANY BACKGROUND

This study was conducted during the period May 1985 through June 1986 at the HP Personal Office Computer Division (POD) located in Sunnyvale, California. During its 1985 fiscal year, HP as a whole employed 84,000 persons worldwide and earned net income of $489 million on revenues of $6.5 billion. HP operated 23 U.S. and 14 international manufacturing facilities, and it maintained sales and support offices in 100 cities in the U.S. and 275 other locations in 75 countries. As part of HP's measurement, design, information, and manufacturing equipment and systems product group, the Personal Office Computer Division had world-wide responsibility for the manufacture of personal computers, including research and development responsibility.

POD was formed in November 1982, when HP combined two previously existing divisions into a single entity to produce and market terminals and printed circuit boards, with terminals representing two-thirds of total sales. In March 1983, HP decided to focus on a new personal computer being designed at POD as its high-volume entry into the microcomputer market, and POD was reconfigured to concentrate on this product line. The product line eventually included two personal computers, the HP150 Touchscreen (hereafter called Touchscreen) and the HP Vectra. Introduced in October 1983, the Touchscreen is an MS-DOS personal computer featuring an innovative touch-screen monitor that uses a matrix of light-beams embedded along the sides of the display. The Vectra is a somewhat larger personal computer that is compatible with, and a competitor to, the IBM PC/AT; it was introduced in October 1985.

HP's Grenoble (France) Division also manufactured these two microcomputers for the European market. Both the Sunnyvale and Grenoble sites produced only the system processing units; keyboards were manufactured by the HP-Singapore Division and other accessories were produced in Puerto Rico. Essentially all of POD's output was delivered to the Personal Computer Distribution Center (PCDO) located in San Jose, about five miles away. PCDO was responsible for domestic distribution of POD's microcomputers as well as 15 other product lines. However, POD made its own market forecasts and set its own production schedules, although POD and PCDO coordinated deliveries.

Approximately 1,025 employees were employed at POD, which was contained entirely within one building. Figure 1 displays the internal organization of POD, while Figure 2 depicts the details of the accounting function within the Finance Department.

MANUFACTURING AT POD[4]

During the ten months preceding the Touchscreen decision (November 1982–August 1983), POD made 50 types of circuit boards and 12 kinds of terminals. Production was organized as a pure batch process in which specific work orders were generated to meet customer orders or to replenish inventory; the number of units produced per work order varied widely. Carts containing the necessary parts for the order originated from raw material stores and were routed through a series of work stations where subassemblies were completed and integrated into the final product. From issuance of work order to completion, a typical batch spent about six weeks in

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[4] Several portions of this section are condensed from Finley and Harrison [1984].

FIGURE 1
PERSONAL OFFICE COMPUTER DIVISION

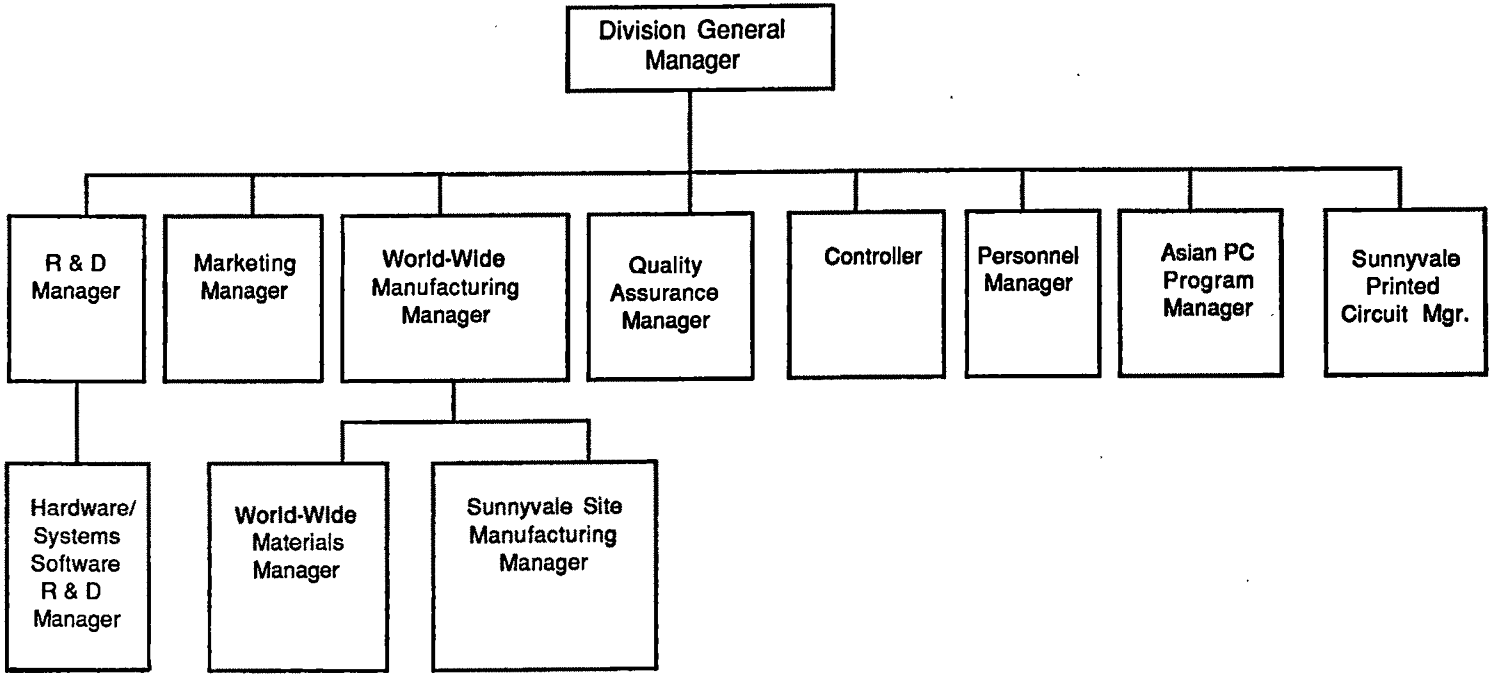
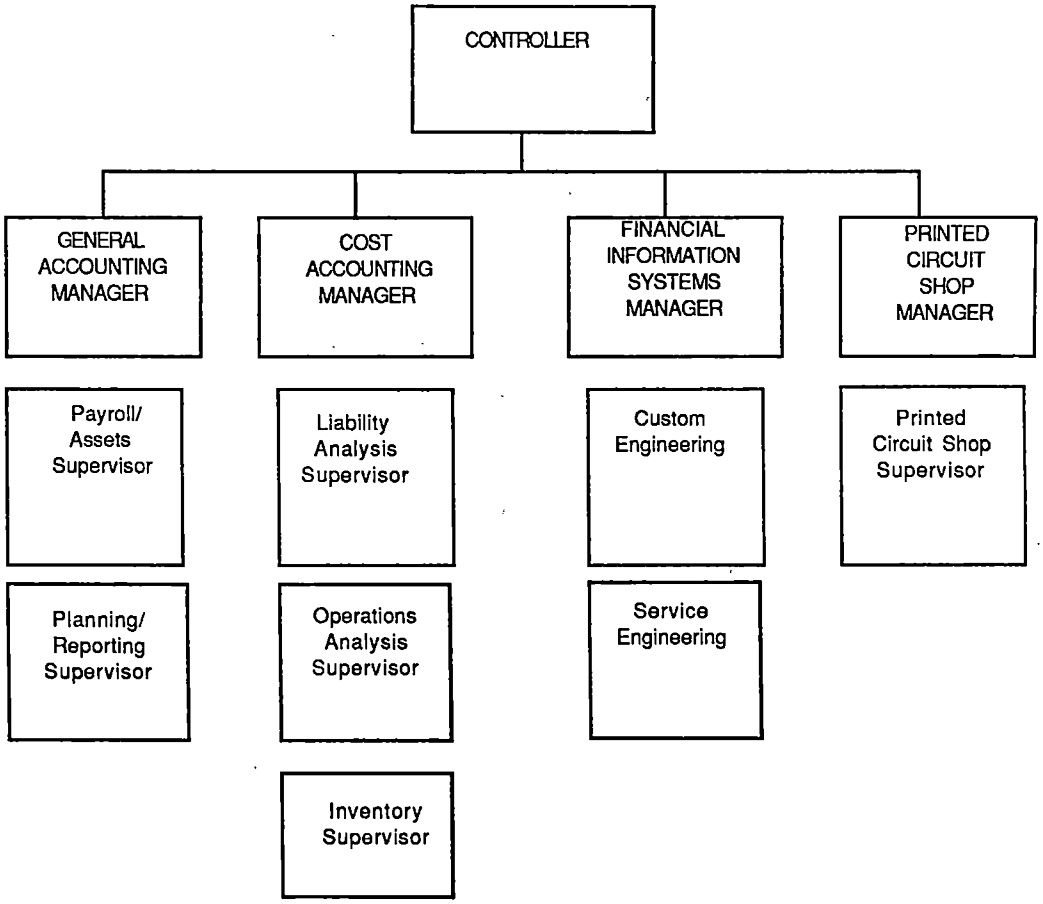

Division General Manager
R & D Manager
Marketing Manager
World-Wide Manufacturing Manager
Quality Assurance Manager
Controller
Personnel Manager
Asian PC Program Manager
Sunnyvale Printed Circuit Mgr.
Hardware/ Systems Software R & D Manager
World-Wide Materials Manager
Sunnyvale Site Manufacturing Manager

FIGURE 2
PERSONAL OFFICE COMPUTER DIVISION
FINANCE


CONTROLLER
GENERAL ACCOUNTING MANAGER
COST ACCOUNTING MANAGER
FINANCIAL INFORMATION SYSTEMS MANAGER
PRINTED CIRCUIT SHOP MANAGER
Payroll/ Assets Supervisor
Liability Analysis Supervisor
Custom Engineering
Printed Circuit Shop Supervisor
Planning/ Reporting Supervisor
Operations Analysis Supervisor
Service Engineering
Inventory Supervisor

production, with costs being accumulated on the work order in a more-or-less textbook fashion. Raw materials were stored on the factory floor, and together with the work in process inventories at the various work centers, occupied approximately 50 percent of the factory floor space. Finished goods were transferred to a nearby warehouse. As a rough measure of manufacturing process quality, management estimated that approximately ten percent (dollar value) of all purchased material ultimately was lost as scrap.

Design of the Touchscreen began early in 1983, and in March HP decided to position the product as a major new entry in the personal computer market. Because Touchscreen's estimated sales volume would be ten times greater than a typical data terminal product, three major decisions were made:

1. Production of other terminal products would be transferred to other divisions or to subcontractors. Over the course of the next three years, several of these products

were discontinued entirely. POD also would subcontract fabrication of keyboards to the HP Singapore Division, and one major circuit board with high labor content would be subcontracted to an outside vendor.

2. Production would be scheduled to maintain level production rates. Only the main system processing unit would be made at POD, and units would be produced to stock and shipped immediately to PCDO, where they would be combined with keyboards, printers, etc., for final distribution.
3. The manufacturing process would use JIT techniques. Two elements were stressed initially. First, raw material and work-in-process inventories would be strictly limited, so that parts were provided to the next production stage only as needed. Second, production along the entire assembly line would be stopped if parts were missing at any stage.

In part, these changes were adopted simply to meet the impending jump in scheduled production volume and to provide space for the production lines and associated inventories of parts and subassemblies. However, at about this time published descriptions of JIT manufacturing at firms like Toyota (and at least two other HP divisions) began to document substantial improvements in quality attributed to two features of JIT (see, for example, Schonberger [1982, 1986]). First, defective parts or subassemblies were said to be caught quickly before they could be built into a large number of units. Second, workers were cited as becoming more involved in quality because a defect at any station could shut down the whole line. HP had begun to emphasize quality assurance at POD prior to the decision to install JIT procedures, so many causally separate quality control improvements developed chronologically in parallel with JIT. Nevertheless, quality control aspects were said to contribute substantially to the decision to convert to JIT methods.

The Production Process

The production process at POD consisted of two main sections that operated in series: printed circuit board assembly (PCA) and final assembly and test (FA&T). The PCA lines produced circuit boards used in both the Touchscreen and Vectra computers. The first version of the Touchscreen contained seven circuit boards, six of which were assembled from component parts at POD. The major steps in the PCA process were:

1. Automatic insertion of components onto boards, using sophisticated loading equipment. About 50 percent of the components were inserted in this way;
2. Hand insertion of parts that required special preparation;
3. Wave soldering of components to boards;
4. Backloading, i.e., hand attachment of components that could not withstand wave soldering; and
5. Final testing.[5]

The Touchscreen and Vectra then had separate FA&T lines, although the following generic process description will serve for either product:

1. Unpacking and initial test of chassis assemblies that were delivered directly to the FA&T line;
2. Hand attachment of boards and

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[5] Other inspection processes occurred at earlier workstations.

other major subassemblies to the chassis;

3. A turn-on test, with the possibility of moving units that fail to a rework station;
4. A Power-Cycle (Burn-in) test lasting approximately three hours, during which time the units resided on a slow-moving conveyor belt;
5. Button up, i.e., adding plastic trim and closing the housing;
6. Final test;
7. Packaging for delivery to PCDO.

The Touchscreen system processing unit was entirely standardized, while five different models of the Vectra were produced on the same line. The models differed primarily in their combinations of RAM and disc drive, and the daily production schedule set the mix of Vectra model types.

JIT Procedures in FA&T

JIT procedures were introduced first in FA&T, where they evolved to include card techniques to which HP referred as KANBAN.[6] An external supplier delivered chassis assemblies directly to the FA&T lines on a daily basis, in boxes which carried KANBAN cards. During the day, cards were pulled from the boxes as the chassis assemblies were needed. The cards were accumulated at the delivery point, logged, and returned to the driver or material handler to initiate the next day's delivery. About one and one-half day's usage was held at POD as a safety stock.

The finished circuit boards produced in PCA were transferred to a buffer at the head of each FA&T assembly line, with the different boards used in the Touchscreen and Vectra products placed in the appropriate line. Set points (i.e., minimum allowable levels) in each buffer regulated the production flow in PCA, and a materials handler reloaded each buffer several times daily with transfers from the PCA line.

Under the JIT implementation rules, only two units were allowed to be held between work stations on the FA&T lines, plus the unit in process at the station.[7] If a defect was discovered, investigative action was taken immediately, which could result in shutting down the line. The overall cycle time on FA&T was about five hours for Touchscreen, which included a total of approximately three and one-half hours of testing.

JIT Procedures in PCA

The PCA line converted to JIT somewhat later, and the JIT procedures underwent more modification there. By the end of this study, the PCA raw material stores inventory on the plant floor contained about seven days worth of parts, stored in standard-sized boxes in racks. The standard quantity in a box varied by part number, with many in the range of 800 to 1,000 parts.

Originally, a KANBAN-like system was installed with a separate card for each individual box. However, this proved unwieldy, as too many cards were being handled and misplaced in the stores area. Eventually, as a box of parts was pulled from stores by a line operator, a data entry ("cashing") transaction was made directly into the computerized inventory tracking system discussed later in this paper. As the boards were assembled, a maximum of three units were allowed to accumulate between work stations prior to the wave soldering operation. Downstream from wave soldering, the allowable buffer was ten units.

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[6] Although KANBAN was the expression used by HP, this term appears to cover a wide variety of inventory control techniques at different companies. See, for example, Neumann and Jaouen [1986].

[7] An exception, of course, was the conveyor holding units during the burn-in test.

TABLE 1
INVENTORY REDUCTIONS AND MATERIAL HANDLING STATISTICS

	Inventories (percent of 11/83 amounts)			
	11/83	*10/84*	*11/85*	*04/86*
Raw Material	100%	56%	39%	28%
Work in Process	100%	24%	27%	11%
Persons Handling Touchscreen Parts Before Production Line	90	28	33	20

Production Process and Product Design Changes

Although this description may give the impression of an initial "changeover" to JIT manufacturing followed by a series of small refinements, in practice many of the subsequent changes were relatively drastic. Moreover, other significant changes occurred in both the product and the manufacturing process. For example, the Touchscreen computer underwent sequential design changes that were, for the most part, transparent to the user but which had significant effects on the assembly of the product. Three separate models of the Touchscreen had been produced between October 1983 and the end of this study. The first two models had lifespans of only 11 and eight months, respectively; the HP150C Touchscreen (the third model) passed the one-year mark in June 1986.

A major Touchscreen redesign effort was directed toward reducing the number of separate parts, especially hand-loaded parts. The first and second models each had over 500 part numbers, while the HP150C parts list contained less than 150 numbers. The main technical feature of the new Touchscreen design was the reduction from seven printed circuit boards to one.[8] Material costs were cut by 50 percent, and the board reduction together with other process changes reduced assembly time by over two-thirds (from 4.22 to 1.32 hours, not counting burn-in testing), with a corresponding drop in direct labor cost.

The physical layout of the plant and the assembly procedures underwent major modifications both to accommodate the product design changes and to effect other improvements in the production process. Over the 29-month period from October 1983 through February 1986, the shop floor was reconfigured at least four times. In addition to identifying changes in assembly procedures to reduce work-in-process inventories and improve quality, POD made changes in material handling prior to production, with concomitant reductions in indirect labor charges. Table 1 displays the reductions in raw material and work-in-process inventories that were achieved (using the end-of-year-one values of the 150A as a basis of comparison).

QUALITY ASSURANCE AT POD

Most discussions of JIT manufacturing emphasize improvements in quality because JIT procedures detect failures quickly and with little or no buffer stock between operators, defective parts will have been built into only a few units

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[8] There were actually two such boards, as there was still a small board attached to the rear of the monitor assembly.

TABLE 2
DEFECT ANALYSIS MATRIX (BY WEEK)

Part No.	*Number of Failures*		
	Before Turn-on	*After Turn-on*	*Field*
x			
y			
z			

before they are detected downstream. However, production along the whole assembly line can be interrupted until a problem is identified and corrected, so if one is to achieve reasonable flow rates with JIT, the number of failures must be small.

One can embark, however, on a total quality mission without necessarily adopting JIT manufacturing. HP's top management decided to strive for a Total Quality Process late in 1980, well before either the merging of divisions that produced POD or the later introduction of JIT. Even after 1983, many important aspects of POD's quality assurance program developed independently from but in parallel with the JIT evolution, although the two endeavors are symbiotic and eventually they became inextricably intertwined.

A one-person Failure Analysis Laboratory was set up in 1981, staffed by a reliability engineer who had worked previously in another HP laboratory facility. Throughout the period covered by this study, this unit was part of Quality Assurance, which reported directly to the Division Manager rather than to Manufacturing. The lab was given a "blank check" to improve quality and its occupant embarked on a self-education program in quality measurement and control. Because circuit board assembly was the main focus in the pre-Touchscreen period, this is where the quest for quality began. As a result, new quality assurance procedures tended to be introduced first to the PCA lines, from which they spread to final assembly.

Some initial data on quality existed in the form of reports from a board replacement program that repaired products that had failed in the field. HP also maintained yield data (i.e., percentage of boards that passed test procedures) in the plant and POD was aware that they were achieving only 40 percent to 50 percent yields while some competitors in Japan were reporting 95 percent yield rates for comparable boards. The first systematic measurement project was a one and one-half-year data collection and correlation study that assembled and analyzed a data base portrayed in Table 2.

It soon became apparent that field data often took six months to be routed back to POD and that report accuracy was uneven, so attention was shifted inward. The first point of attack was in pre-turn-on testing, where conventional wisdom within POD held that low yields (sometimes only 40 percent before turn-on alone) were due to poor-quality components from suppliers. At this time, pre-turn-on testing was done with a "bed-of-nails" apparatus, i.e., a mechanism from which multiple probes extended to make contact with and test many individual components simultaneously. Components that failed were replaced at a rework station, and most failed parts were dumped into bags to await gold reclamation processing.

The first change in measurement procedures took the form of a requirement that Board Repair Operators place every removed part into an envelope and code it with part number, date, symptom, and where in the process that failure was detected. At the same time, the Failure Analysis Lab developed the Failure Analysis Shopfloor Tracking system (FAST, shown on the software schematic in Figure 6) to maintain the data base. Detailed laboratory analysis of the failed parts themselves in conjunction with interpretation of the data base produced three insights:

1. The false negative error rate in the bed-of-nails test procedure was high, and the assumption of large percentages of defective parts from vendors was largely incorrect. Many of the parts that were removed were not, in fact, defective. Both design problems and poor maintenance of the test mechanisms appeared to be at fault.
2. A significant portion of the true negatives (i.e., boards that were in some way defective) were due not to defective components but rather to faulty interconnects between the components, and the test procedures were not designed to detect this situation.
3. A few vendors actually were delivering components with high defect rates, and some others occasionally would drift in and out of this condition.

Steps were taken to remedy each of these problems:

1. The bed-of-nails testers were replaced with electronic tool (ET) testers, which, in essence, test the whole board for functionality rather than its component parts. At later dates and at higher-level assemblies (up through the complete product), this approach evolved into product designs that built in self-test procedures.
2. Layouts of the printed circuit boards were changed to reduce the number of inadvertent solder bridges and other interconnect defects.
3. Certain vendors were dropped, and others were helped to understand and correct their own manufacturing problems.

These changes eventually led to ten-to-one improvements in quality; in 1980 it was not uncommon to replace 11,000 parts per month before turn-on, while in 1985 only 1,000 parts-per-month might be replaced in total (i.e., both before and after turn-on) at roughly comparable volume levels. Moreover, the quality assurance group believed that another five-to-one reduction might be achieved by changes that had been or would be induced by their tracking procedures.

The advent of computerized wand reading of barcodes printed on adhesive strips or serial number faceplates roughly coincided with the redesign of the POD production lines to produce the Touchscreen. This new data collection technology aided the quality assurance group in extending its focus further downstream in the PCA line and eventually to the FA&T line. FAST was rewritten to utilize barcode information, and barcode strips were printed and attached to all boards as they entered the PCA line, as well as to assemblies entering the FA&T line.

Thus began a second round of data collection, analysis, and corrective action. Using the barcode information read in at the rework stations, FAST accumulated a board repair data base for approximately one year. Again, an important insight emerged: between 30 percent and 40 percent of the rework was devoted to boards that had already been reworked at least once. It became clear that the component replacement process (particularly the heat dissipation involved) damaged previously perfect components or interconnects. The operational response was a simple decision rule: if (after any rework) a board fails a second time, discard the entire board. An ancillary lesson learned here concerned the increased importance of avoiding false negatives in any test process because reworking a perfect board often wrecked it.

Note that both cycles of measurement, analysis, and response described here recount the successes achieved by a dedicated "quality guru" who earned respect and credibility by individual hard work. They were not the result of the cooperative efforts of the entire production force typically ascribed to a JIT program. However, as JIT took hold at POD, quality assurance again extended its measurement program in a way that both spread its influence more evenly throughout the entire assembly process and dovetailed more closely with the JIT approach.

The focus of the quality assurance program was broadened to encompass the production process *qua* process as well as the product. This theme was captured succinctly in the statement: "A cycle time that is more than two sigma away from the mean is just as much a defect as a computer that doesn't work." Up to this point, FAST data entry had occurred only at the rework stations. To monitor the production process itself, FAST barcode reading equipment was installed at strategic points along the assembly lines, and measures of both the level and the variability of the production rate were compiled. For example, the variability of the production rate was measured by its "Linearity," which was defined as one minus the coefficient of variation of the hourly production rate.[9] That is:

$$\text{Linearity} = 1.0 - \frac{[\text{Standard Deviation (Hourly Build Rate)}]}{[\text{Mean (Hourly Build Rate)}]}$$

In addition, the FAST barcode system was not the only source of information on quality. As each Touchscreen chassis reached the turn-on test station, a "Process Sheet" was attached which carried the unit's serial number and its sequence number on the line (see Figure 3). As the unit passed down the line, the operators entered the time and the codes taken from either the external test equipment or the built-in test readouts.

The assembly lines also operated under strict JIT rules regarding the procedures to be followed when a defect was discovered; Figure 4 summarizes the system response. Note that a lot size here referred to a set of units to be inspected when a defect was discovered. As Figure 4 indicates, if a second defect was found in the specially monitored group of 20, the line was shut down until the cause was located and corrected.

Shut-down of the line triggered a meeting of a CEDAC committee (Cause and Effect Diagram with the Addition of Cards). In this group problem-solving approach, the production line operators

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[9] Since variability of the production rate is undesirable, one seeks to raise the linearity score toward a maximum of 1.0

FIGURE 3
HP150C PROCESS SHEET

Serial # Sequence #

(1) *Turn-On Test*: Pass / Fail Emp. #________ Date ___/___/___
1st Fail Code ________ Date ___/___/___
2nd Fail Code ________ Date ___/___/___

(2) *Power Cycle*: In Time ___:___ Date ___/___/___
High *POT* Test |____| |____| Yes / No ________ Emp. #
1st Fail Code ________ Date ___/___/___ Time ___:
(2nd) In Time ___:___ Date ___/___/___
2nd Fail Code ________ Date ___/___/___ Time ___:
(3rd) In Time ___:___ Date ___/___/___
3rd Fail Code ________ Date ___/___/___ Time ___:

(3) *QC Test*: Passed Date ___/___/___ Time ___:
Passed Date ___/___/___ Time ___:
1st Fail Code ________ Date ___/___/___ Time ___:
2nd Fail Code ________ Date ___/___/___ Time ___:
3rd Fail Code ________ Date ___/___/___ Time ___:

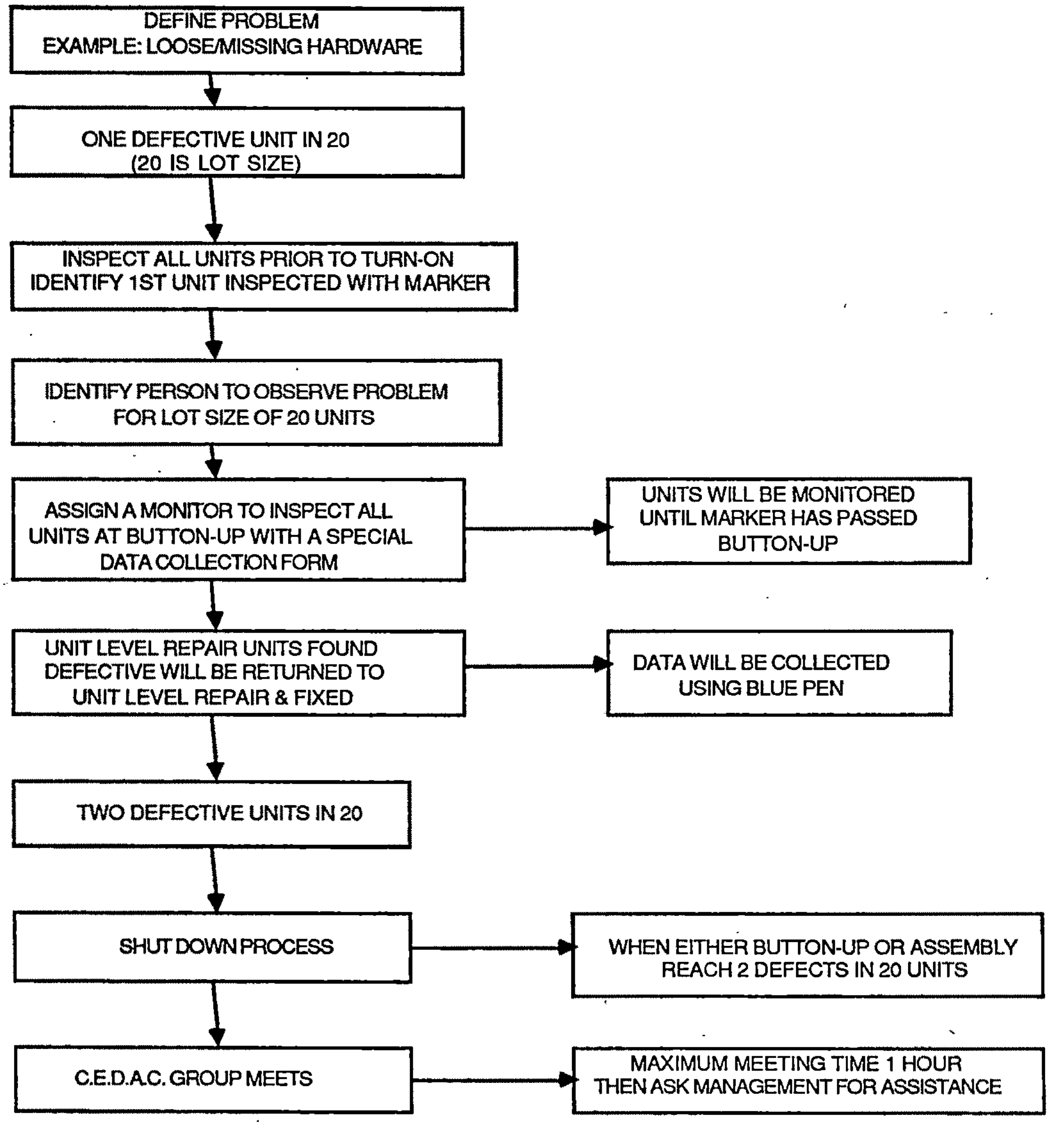
(4) *Final QC*:
Rejected Passed Emp. #________ Date ___/___/___ Time ___:
Fail Code/Descrip. ________
High *POT* Test Verified |____| |____| Yes / No

(5) *Rework Station*:
1st Repair ________ Date ___/___/___ Time ___:
2nd Repair ________ Date ___/___/___ Time ___:
3rd Repair ________ Date ___/___/___ Time ___:

brainstormed to list as many potential causes as they could generate. Each potential cause was written on a separate card and, together with the supervisor, the group defined performance measures that would indicate which causes were to blame. Each operator, for example, used a sheet of paper containing four ruled grids to construct bar charts of the frequency of the potential causes or error types that occurred at his or her station. These data were shared among the group, and the supervisor wrote a memorandum outlining both the potential causes and the frequency of each, together with proposed corrective changes (and eventually the extent to which the implemented changes did help). Supervisors also could extract data from FAST for use by their production group. The records generated by a CEDAC committee were shared more widely in weekly Quality Council meetings attended by the Engineering and Manufacturing Managers. Eventually, data from all of these sources were compiled and

Figure 4

Quality Control Process Flow Chart

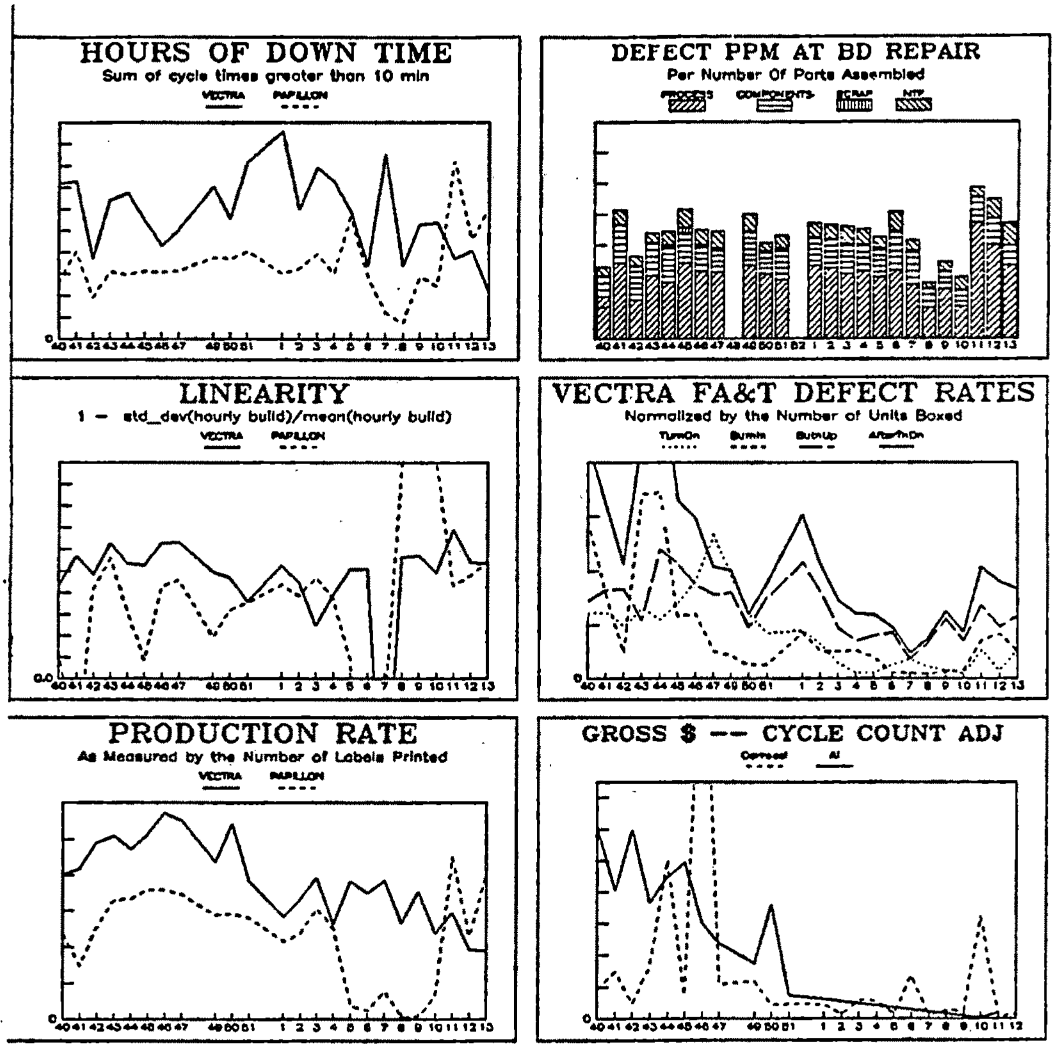

DEFINE PROBLEM
EXAMPLE: LOOSE/MISSING HARDWARE
ONE DEFECTIVE UNIT IN 20
(20 IS LOT SIZE)
INSPECT ALL UNITS PRIOR TO TURN-ON
IDENTIFY 1ST UNIT INSPECTED WITH MARKER
IDENTIFY PERSON TO OBSERVE PROBLEM
FOR LOT SIZE OF 20 UNITS
ASSIGN A MONITOR TO INSPECT ALL
UNITS AT BUTTON-UP WITH A SPECIAL
DATA COLLECTION FORM
UNITS WILL BE MONITORED
UNTIL MARKER HAS PASSED
BUTTON-UP
UNIT LEVEL REPAIR UNITS FOUND
DEFECTIVE WILL BE RETURNED TO
UNIT LEVEL REPAIR & FIXED
DATA WILL BE COLLECTED
USING BLUE PEN
TWO DEFECTIVE UNITS IN 20
SHUT DOWN PROCESS
WHEN EITHER BUTTON-UP OR ASSEMBLY
REACH 2 DEFECTS IN 20 UNITS
C.E.D.A.C. GROUP MEETS
MAXIMUM MEETING TIME 1 HOUR
THEN ASK MANAGEMENT FOR ASSISTANCE

summarized in a weekly Production Operations Report like the one shown in Figure 5, that was available to the Accounting Department, among others.

Cost Accounting at POD

POD maintained a complex system of computer software modules to manage information flows. The overall system configuration appears in Figure 6, although many of the main elements resided on separate computers. The system itself, like its graphical representation, can be somewhat overpowering, and the

FIGURE 5
PRODUCTION OPERATIONS REPORT
4/05/86 WEEK = 13

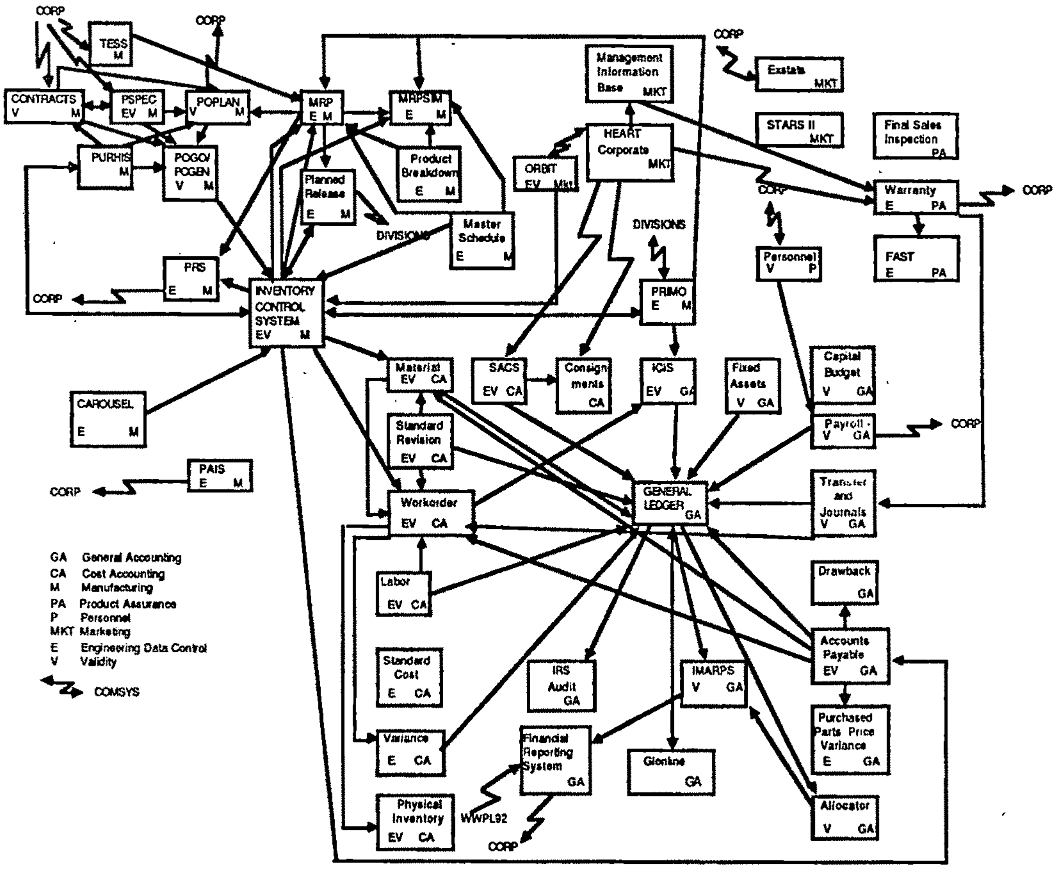


Note: y-axis has been deleted

impetus to reduce the infrastructure at POD included efforts both to simplify the software network and, in some instances, to eliminate the need for automated data processing altogether.

The cost accounting segment included the Sales and Cost of Sales System (SACS) and the set of modules known as COSACS2. Originally designed as a "work order tracking" tool, SACS was used to track all sales of products, parts, and accessories from the division. It also was used to reconcile shipments to the General Ledger to ensure product shipment accuracy. SACS included a routine called Consignment, which recorded the

FIGURE 6
PERSONAL OFFICE COMPUTER DIVISION
MANAGEMENT INFORMATION SYSTEM, FY 1985



sales of products on consignment. The COSACS2 components are clustered in the lower central portion of Figure 6, with self-explanatory module names: Physical Inventory, Workorder, Material, Labor, Standard Cost, Standard Revision, and Variance. These programs were used widely throughout HP, but as POD moved away from a true workorder environment, the need for adaptation or replacement of COSACS2 became apparent.

Three other systems interacted frequently with COSACS2:

1. *Inventory Control System* (ICS). This was both a material tracking/stores control module and a production/procurement order maintenance program. It was used to maintain the on-hand balance of parts in stores, hold open purchase orders and process dock receipts, record pulls of PCA raw materials, maintain the backorder file, transmit material movement and material accumulation charges to COSACS2, and perform a host of other functions.

2. *ORBIT.* This was a perpetual finished goods inventory system that received and acknowledged order requirements from the sales office and processed shipment data.
3. *HEART.* This was the sales order system residing at Corporate Headquarters that received daily orders from sales offices and transmitted them to the supplying divisions.

Budgets and Standard Setting

For both planning and product costing, much of the accounting activity at POD was organized within the two six-month cycles comprising the October 31 fiscal year. POD used a standard cost system together with other target items to formulate a six-month operating budget; the six-month target production volume implied a total standard production cost which, when combined with period cost targets, yielded a semi-annual net income goal. Monthly production plans provided intermediate targets from which monthly variance reports were generated.

The per-unit standard costs were revised every six months, and the standards were set to be achievable by the end of the six-month period, so they implicitly involved learning and other process improvements.[10] The standards were reviewed monthly for the first three months of the period to see if they were grossly inappropriate. A revision was possible at the discretion of the divisional controller, although such revisions were viewed as extremely rare events.

Preparation of the next period's standards began at about the three-month point and was estimated to consume the equivalent of one full-time person for two and one-half months. Material cost estimates were supplied by the division's buyers; the production line supervisors supplied direct labor estimates in the form of production rates, standard times per operation, and wage rates. Targets for indirect labor were obtained from production, procurement, and support. These were allocated through the overhead procedure described below. Finally, an internally-generated market forecast drove the production plan, which implied a denominator volume for the various application rates.

Figure 7 contains the "POD Cost by Process Diagram" that was used to lay out labor, overhead, subcontracting, and administrative targets for the fiscal year. Although the version shown in Figure 7 contains only percentage data in some of the fields, this planning and control document had become a standard communication format within POD, in which target and actual dollar expenditures were displayed for each category. Its intended effect was to heighten awareness of and assign responsibility for factory overhead. It also served as a plan of attack for cost reduction. Although the document shown is labeled "Targets, FY 1985," the cost accounting group continually updated the actual "year to date" displays, and the diagram was used to discuss changes in targets, the likely effects of process changes, etc. In interpreting Figure 7, note that System Accessories and Support refers to the supply of parts that POD maintained to meet demands for repairs or accessories over the life cycle of products it had produced, often extending up to ten years.

Overhead allocation and application procedures underwent major revisions during the time period covered in this study. In February 1983, as design-

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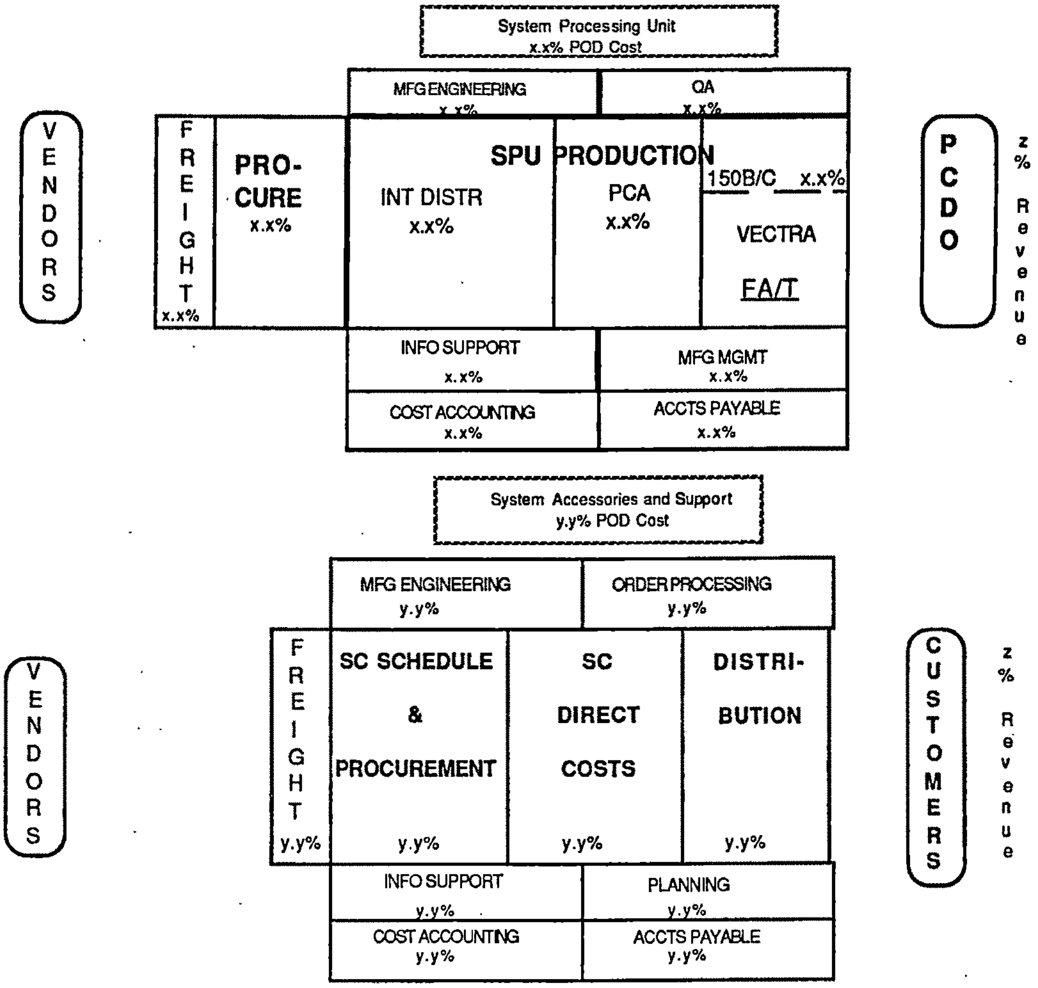
[10] Therefore, the monthly variances were expected to be unfavorable at the beginning of each semi-annual period, with gradual reduction, and perhaps reversal, by the end of each such period.

FIGURE 7
POD COST BY PROCESS DIAGRAM
LABOR, OVERHEAD, SUBCONTRACT, AND ADMINISTRATIVE TARGETS, FY 1985



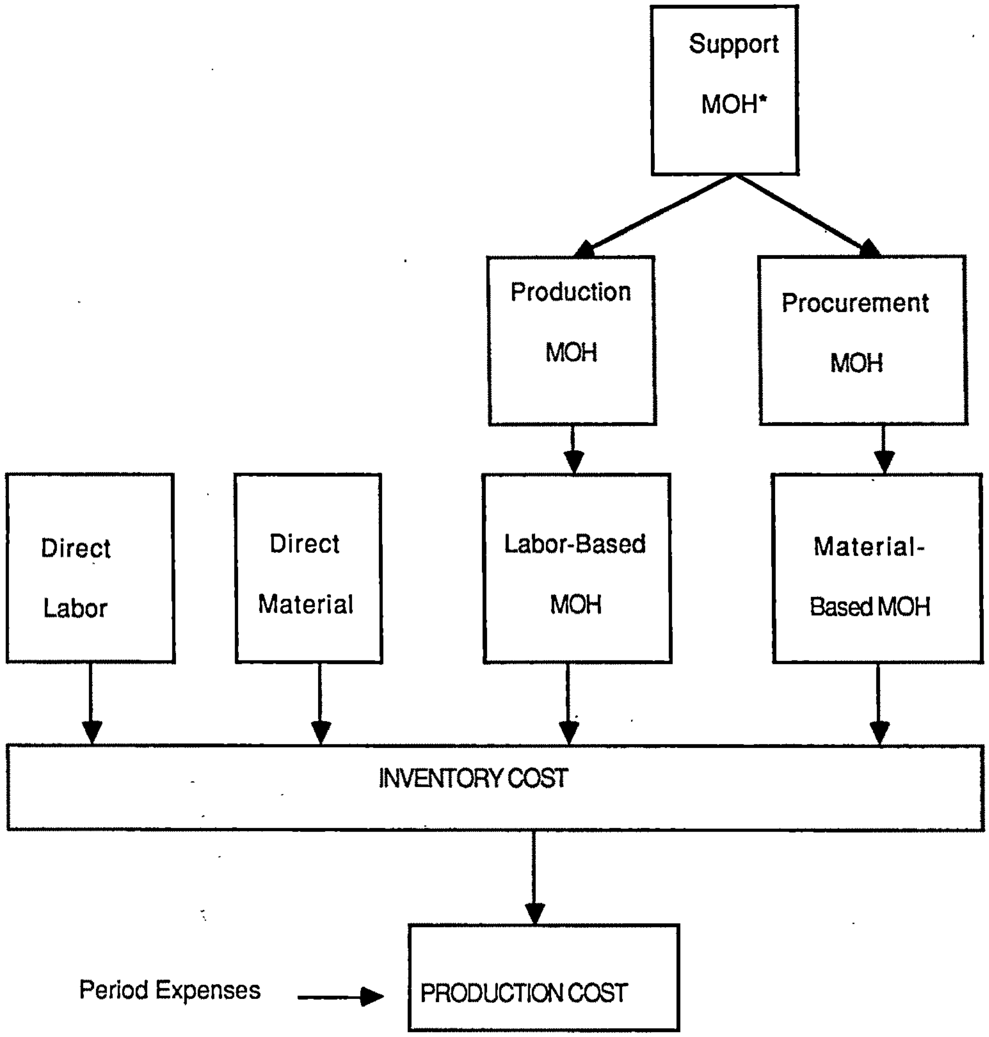
changes and subcontracting arrangements were reducing the direct labor content of many of HP's products, a task force was established at the corporate finance level to analyze HP's use of direct labor as the basis for allocating manufacturing overhead costs to parts and products. The resulting new system, which came online at POD in August 1985, used two application rates, a labor-based rate for production overhead and a material-based rate for procurement. A schematic representation appears in Figure 8.

The allocation process portrayed in Figure 8 involved three overhead accumulation accounts or "buckets," as follows:

1. *Support Manufacturing Overhead Costs.* Costs captured in this bucket were those that supported the

Figure 8

Dual Application Rate for Manufacturing Overhead



* MOH = Manufacturing Overhead

overall manufacturing process, both production and procurement, without a specific causal relation to any direct manufacturing element. These expenditures included manufacturing engineering, quality assurance, manufacturing management, and central electronic data processing (EDP) support, including allocations from administration. Various bases were then used to allocate this support overhead between the Production and Procurement buckets, including estimated percentages of time devoted to the two areas and the relative personnel counts of the production and procurement groups.

2. *Production Manufacturing Overhead Costs.* In addition to those items allocated from the first bucket, this area included direct labor benefits, direct labor supervision, indirect labor, supplies, depreciation, and other operating expenses related to the production, assembly, test, and shipping functions.
3. *Procurement Manufacturing Overhead Costs.* Again in addition to allocated items, this area included purchasing, receiving, incoming inspection, stockrooms, material handling, production planning and control, freight-in expense, manufacturing specification costs, materials engineering, subcontracting, and corporate materials charges.

The same overhead rates were applied to both the Touchscreen and Vectra products, and to both the PCA and FA&T lines. At various times preceding the two-basis system, overhead application rates at POD had ranged from 600 percent to 1,600 percent of direct labor cost, and different rates had existed for different models of the Touchscreen. Even with the dual application system in place, the labor-based application rate had exceeded 500 percent in some periods, while the material-based rate usually fell in the ten percent to 30 percent range. Note, however, that the direct material costs per unit of the Touchscreen and Vectra greatly exceeded the direct labor costs per unit, which tended to counterbalance the application rates so that comparable dollar amounts of overhead were applied to the products through labor and through materials. Nevertheless, the sensitivity to variation in the basis remained much higher for the labor-based manufacturing overhead.

THREE ADAPTATIONS TO JIT

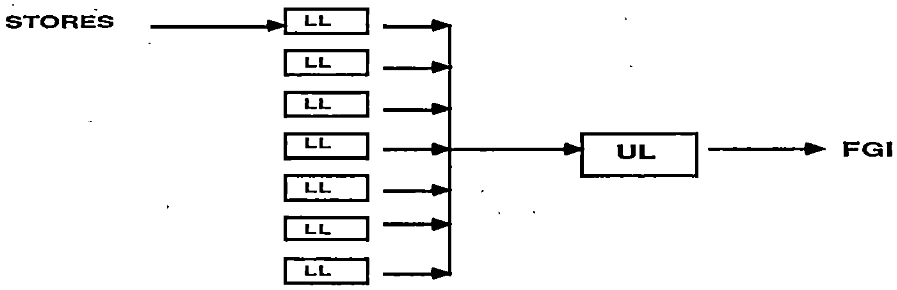
Before the introduction of JIT at HP, all products were produced in and accounted for as batch jobs, with costs accumulating on the work orders as the batches passed through work centers. As JIT gradually transformed the production process into one more closely resembling the continuous flow of undifferentiated units, the cost accounting system might have been expected to evolve toward process costing. This section describes three discrete sets of changes that roughly conform to this hypothesis: perpetual work orders, passive labor vouchering, and streamlined relations with suppliers.

Perpetual Work Orders

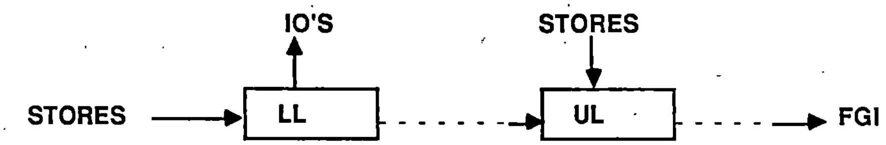
As indicated in Figure 6, all of the computer-based inventory tracking systems were perpetual: ICS for stores and work in process (WIP) and ORBIT for finished goods (FGI). Because finished computers were shipped to PCDO daily and ORBIT was relieved at each shipment, little change in the finished goods accounting system was necessary. However, significant adaptations occurred in the WIP procedures. When Touchscreen production began, the WIP data flows were modeled after actual material flows in the production process. As Panel A of Figure 9 indicates, a "Multi-Bucket" work-in-process system designated each of the seven PCA lines as a "Lower Level" (LL) work-in-process station, within which standard and actual quantities and times were recorded daily. Unit transfers to the FA&T lines (which were designated "Upper Level" (UL) work-in-process stations) were recorded as they occurred and ORBIT tracked units from WIP to FGI on a daily basis. COSACS2 then integrated dollar amounts with the unit data in a batch computer job each night.

FIGURE 9

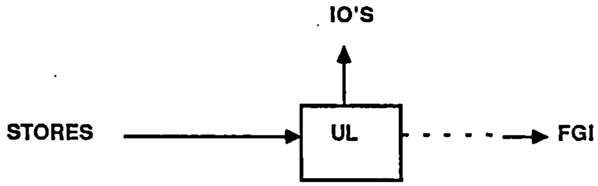
Panel A
Multi-Bucket Work In Process



Panel B
Double Bucket Work In Process



Panel C
Single Bucket Work In Process



Solid Line = ICS Transaction
Dotted Line = Journal Entry
LL : Lower Level Printed Circuit Board Assembly Lines
UL : Upper Level Fabrication and Test Lines
FGI: Finished Goods Inventory
IO : Internal Order

The first change occurred when the number of boards in the Touchscreen was reduced to only one (excluding the small monitor board). The production process was represented as a "Double Bucket" WIP system in which the entire Lower Level PCA area and the entire Upper Level FA&T area each became a single work-in-process accumulation point. This system was in place at the close of the study and is shown in Panel B of Figure 9.[11]

[11] The reader should bear in mind that the single PCA line produced different boards for Touchscreen and Vectra, which in turn were assembled on two separate FA&T lines.

Then, perpetual work orders were introduced. In the perpetual work order system, ICS continued to track units and accumulate costs internally on a work order basis, but it was "tricked" into using a single work order that remained open for the full six-month accounting period. At the end of the period, the work order was closed on COSACS2 through a manual journal entry that triggered "post-deduct" or "back-flush" calculations. That is, the operator instructed the system to total the actual number of finished units transferred to ORBIT during the period, and to aggregate all standard and actual costs associated with those units. Variances were calculated, which the operator manually closed to the General Ledger, thus zeroing out the work order. A second manual journal entry then re-opened a new six-month work order on COSACS2, including the current WIP balance.

Ultimately, POD planned to move to the "Single Bucket WIP" system shown in Panel C of Figure 9, unless other changes in the accounting software (e.g., complete replacement of the ICS and COSACS2 modules) intervened. When the entire production process is treated as a single work-in-process accumulator and the event that triggers the "post-deduct" averaging of costs over production is the close of the accounting period (as it already was) rather than the completion of a specific number of units, the accounting system will have taken on most of the characteristics of pure process costing.

Passive Labor Vouchering

A recent article [Hunt, Garrett, and Merz, 1985] concerning JIT manufacturing and accounting at an HP printed circuit fabrication facility in the Disc Memory Division described a situation in which "direct labor is no longer accounted for as a separate cost." In that system, direct labor is included within manufacturing overhead, which in turn is treated as an expense charged directly to cost of goods sold. Overhead charges associated with the remaining work-in-process and finished goods balances are maintained with end-of-period adjusting entries.

POD used a system that it called "Passive Labor Vouchering," in which direct labor was still accounted for as a separate cost and a direct labor efficiency variance was calculated. However, considerable simplification had been effected, in part because direct labor accounted for less than five percent of the direct costs incurred at POD in assembling the Touchscreen and Vectra products. The accounting group estimated that the Passive Labor Vouchering system had reduced the administrative costs of tracking labor by 15 percent.

To provide the data necessary for Passive Labor Vouchering, employees filled out clock-cards of actual hours worked, paid time-off, sick days, and holidays. POD had a flexible arrival and departure time policy, although there was little variation in arrival times for the direct labor employees. Actual labor costs were calculated by multiplying recorded employee hours by wage rates. Supervisors were responsible for keeping a log of downtime, direct labor hours on special work performed for other divisions, and any other unusual circumstances that arose on the production line during the month. Rework supervisors recorded the number of personnel per month devoted to rework tasks.

ICS computed a monthly "system" (i.e., within ICS's internal database) WIP inventory figure that was verified by and adjusted to a physical count of WIP inventory taken at the end of each

TABLE 3

ACCOUNTING FOR DIRECT LABOR COSTS AT *POD*

Panel A
Labor Costs Applied to Inventory

	Ending *WIP*	[Physical count × standard labor rate]
+	Stockflows to *FGI*	[Units shipped × standard labor rate]
−	Beginning *WIP*	[Physical count × standard labor rate]
=	Direct Labor Applied to Production	

Panel B
Computation of Labor Efficiency Variance

$$\begin{array}{c}\text{Direct Labor}\\ \text{Eff. Variance}\end{array} = \left[\begin{array}{c}\text{Target production}\\ \text{for month}\end{array} - \begin{array}{c}\text{Actual production}\\ \text{for month}\end{array}\right] \times \begin{array}{c}\text{Standard labor}\\ \text{rate per unit}\end{array}$$

Panel C
Labor Costs Included in Manufacturing Overhead

	Actual Direct Labor	[Wages paid or payable]
−	*PTO*; Sick, Holiday, etc.	[Recorded]
=	Available Direct Labor	
−	Direct Labor Applied to Production	[From step 1]
−	Direct Labor Applied to Rework	[Recorded]
−	Billings to other Divisions	[Recorded]
−	Direct Labor Efficiency Variance	[From step 2]
=	Included in Manufacturing Overhead	[Residual]

month. At the time of the study, the direct labor costs were accounted for via the three-step procedure described below:

1. Labor expenditures were applied to WIP Inventory and FGI at standard cost, as is shown in Panel A of Table 3.
2. A labor efficiency variance was computed. Although the actual steps followed were somewhat more involved, the computation can be reduced to the formula shown in Panel B of Table 3. The direct labor efficiency variance was booked to the general ledger as a period expense.
3. Any difference between actual direct labor expenditures and the direct labor cost applied to inventory in step 1 that was not explained by paid absences, rework, billings to other divisions, or the efficiency variance computed in step 2, was treated as an element of manufacturing overhead. The formula for that calculation is shown in Panel C of Table 3.

As a final "reasonableness" check, the computed labor efficiency variance was compared to the cost of the downtime and training hours recorded by the supervisors.

Streamlined Relations With Suppliers

Most discussions of JIT manufacturing emphasize the need to improve the quality of the firm's relations with its suppliers, with respect to both the reliability of the parts delivered and the dependability of delivery schedules (see Hall [1983] or Schonberger [1986]). Typically the firm must have its own JIT program well under way before pushing the concept upstream to suppliers, and this phase seems to be a particularly slow process.

By the end of the study period, POD had modified four aspects of its supplier relations:

1. *Reduction of the Number of Suppliers.* Over the period October 1983 to May 1986, the number of different suppliers for the Touchscreen was reduced from approximately 125 to 39, with 85 percent of the Vectra's parts supplied by these same vendors.[12]
2. *Emphasis on Improved Quality.* An increased emphasis had been placed on improved quality of the parts delivered, so that they could be delivered directly to the assembly line with little or no incoming inspection. At the end of the study period, this was occurring only on the upper-level FA&T lines, for the large chassis/monitor assembly and the plastic housing and trim.
3. *JIT Delivery.* As of April 1986, eight vendors were delivering on a daily JIT basis to POD.
4. *Reduction of the Paperwork Associated with Delivery.* Two aspects of this overall issue were addressed here. First, as the frequency of deliveries increases, the volume of invoices to be processed will explode unless the process is simplified. Second, as the quality of the parts delivered increases and the need for returns (and eventually the need for inspection) falls, the paperwork associated with the return process should fall.

To implement item four, POD had begun to institute a "No Invoice" receiving and accounts payable procedure. This process was intended to capture both parts of item four, i.e., reduced paperwork for both the receipt of good parts and the return of defective parts.[13]

A flowchart description of the "No Invoice" procedure discussed in step four above is provided in Figure 10. To interpret the chart, note that:

1. The term "contact" usually meant a telephone conversation with no mandatory immediate or follow-up written communication.
2. A "transaction" was a computer entry into the ICS system.
3. Receiving documents were accumulated for one week and physically delivered to Accounts Payable on Tuesdays. Accounts Payable input them on Tuesday afternoon or Wednesday morning at the latest, and the software did most of the "matching" to internally stored purchase order numbers.

OTHER RELATED COST ACCOUNTING SYSTEMS

COSTIT

To facilitate continual design work on product enhancement and process improvement, the accounting group maintained a computer program called

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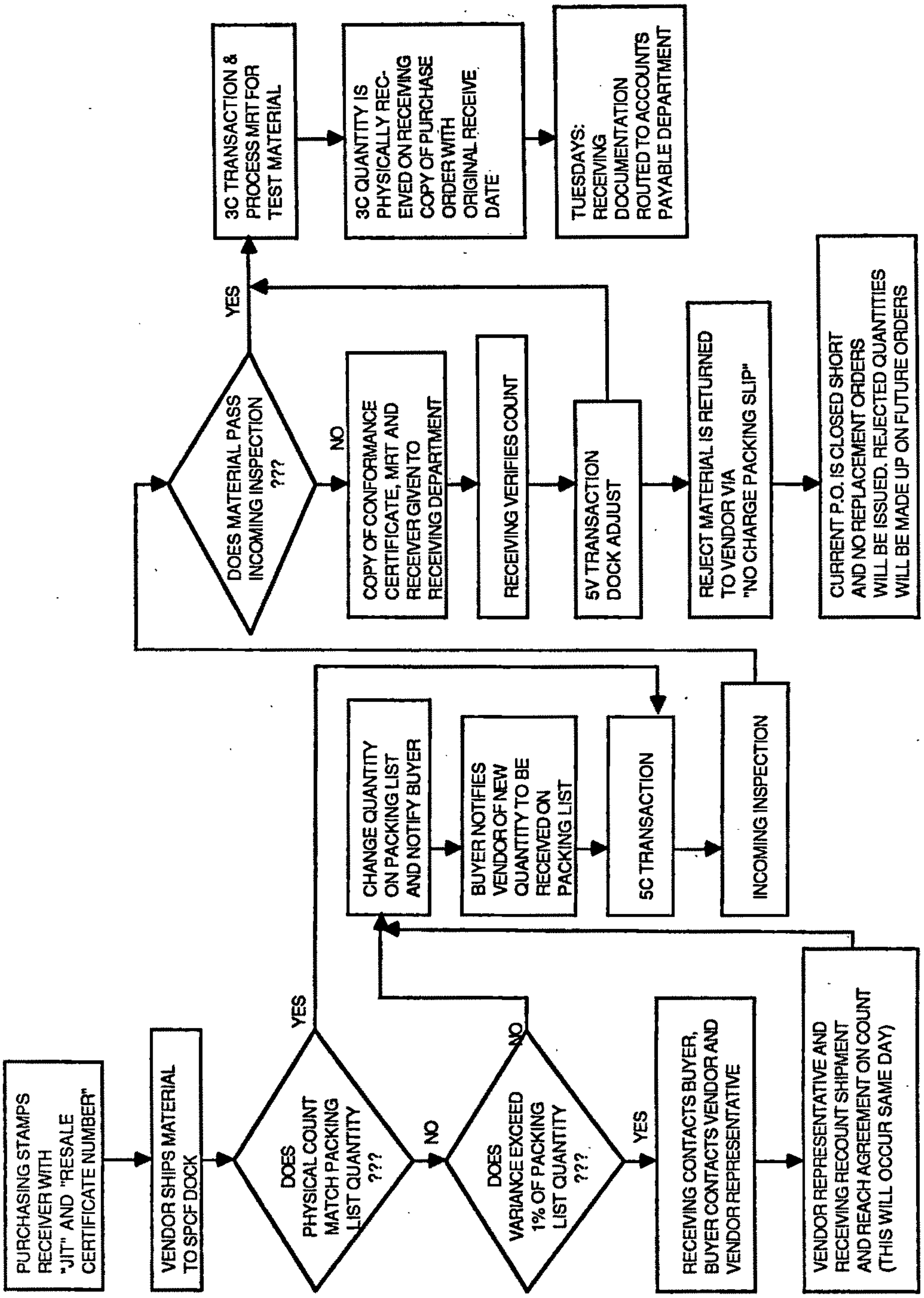
[12] Other HP divisions supplied only about 15 percent of POD's material purchases.

[13] Note, however, that JIT delivery can precede the introduction of a "No Invoice" procedure, and at May 1986, the "No Invoice" process was used with only one of POD's eight JIT suppliers, although it was used with all six of the JIT suppliers at another HP location.

FIGURE 10
“NO INVOICE/DEBT MEMO” PROCEDURE


PURCHASING STAMPS RECEIVER WITH "JIT" AND "RESALE CERTIFICATE NUMBER"
VENDOR SHIPS MATERIAL TO SPCF DOCK
DOES PHYSICAL COUNT MATCH PACKING LIST QUANTITY ???
YES
NO
DOES VARIANCE EXCEED 1% OF PACKING LIST QUANTITY ???
NO
YES
RECEIVING CONTACTS BUYER, BUYER CONTACTS VENDOR AND VENDOR REPRESENTATIVE
VENDOR REPRESENTATIVE AND RECEIVING RECOUNT SHIPMENT AND REACH AGREEMENT ON COUNT (THIS WILL OCCUR SAME DAY)
CHANGE QUANTITY ON PACKING LIST AND NOTIFY BUYER
BUYER NOTIFIES VENDOR OF NEW QUANTITY TO BE RECEIVED ON PACKING LIST
5C TRANSACTION
INCOMING INSPECTION
DOES MATERIAL PASS INCOMING INSPECTION ???
YES
NO
3C TRANSACTION & PROCESS MRT FOR TEST MATERIAL
3C QUANTITY IS PHYSICALLY REC-EIVED ON RECEIVING COPY OF PURCHASE ORDER WITH ORIGINAL RECEIVE DATE
TUESDAYS: RECEIVING DOCUMENTATION ROUTED TO ACCOUNTS PAYABLE DEPARTMENT
COPY OF CONFORMANCE CERTIFICATE, MRT AND RECEIVER GIVEN TO RECEIVING DEPARTMENT
RECEIVING VERIFIES COUNT
5V TRANSACTION DOCK ADJUST
REJECT MATERIAL IS RETURNED TO VENDOR VIA "NO CHARGE PACKING SLIP"
CURRENT P.O. IS CLOSED SHORT AND NO REPLACEMENT ORDERS WILL BE ISSUED. REJECTED QUANTITIES WILL BE MADE UP ON FUTURE ORDERS

COSTIT, which enabled them to generate quickly (i.e., from within minutes to at most two hours) a response to the question: "What would the product cost if certain specific design changes were made?" COSTIT accessed the various modules of the Engineering Data Control (EDC; see the legend in Figure 6) and COSACS2 data base systems that contained current standard part lists for each subassembly and complete product, standard costs by part number, standard direct labor times at the subassembly and complete product levels, standard direct labor wage rates, and current overhead application rates for both material (at the part level) and labor (as it appeared). When queried, the program "rolled up" the standard cost of a product by retrieving and aggregating these data in a dual field display. The "standard field" rolled up the product cost according to current design specifications. The "current field" allowed the user to "turn on" or "turn off" any part or assembly, to estimate total production cost per unit (at current application rates) for a wide variety of design modifications. The accounting group estimated that COSTIT was accessed an average of 100 times each month.

Inventory Control Systems

In monitoring the accuracy of the cost accounting data, POD was continually seeking simplification of systems, process visibility, and quick response to problems. Although for product costing purposes the perpetual work order was closed only at six-month intervals, ICS was recording physical flows on a daily basis. This "system count" was built up from data entries occurring as materials entered either the Lower Level PCA line or the Upper Level FA&T lines.

As described earlier, Lower Level stores consisted of uniform boxes of parts stored on racks; about seven days of parts were held. HP had designed BICS, a Barcoding Inventory Control System, that produced a barcode descriptor for each part type containing information about stores location, part number, quantity, purchase order information, etc. Rather than using a KANBAN card system, a single barcoded card existed for each part type, and as a box of parts was withdrawn from stores, the card was "cashed." Cashing was a computer transaction that reduced the Stores on Hand balance and placed the materials into ICS's Lower Level WIP bucket.

On the Upper Level, the bulky chassis/monitor assembly was delivered directly to the FA&T assembly line, using a full KANBAN card system. KANBAN cards were pulled from the boxes as needed, logged, and accumulated for daily collection and return. A single computer run at night entered these flows into ICS. To avoid extensive reprogramming, the items were entered in a transaction as though they went through the typical delivery and inspection phase that ICS originally was designed to model, although these actions no longer occurred.

All WIP inventory was counted physically every month; this manual process required a two-hour halt of the lines. The physical count was compared to the ICS "system count," and variance reports were created showing, by part number within WIP location, actual versus system quantities and dollars. These reports were distributed to the various WIP locations on the same day, and production personnel checked the discrepancies. After traceable errors were corrected, the final material quantity variance was booked into the General Ledger, and the system count was updated to actual. Portions of the Lower Level stores inventory were counted continually on a scheduled cycle, and the entire stores inventory was counted manually every six months.

Monthly Report Package

A monthly cost accounting report was distributed to the Division General Manager, the Manufacturing Manager, the Controller, the Manager of the Information Systems Department, and Corporate Headquarters. It contained 15 to 20 pages of tables and graphs that can be categorized under four main headings.

Financial Measures:

- POD facility overall manufacturing and production cost analysis;
- The split of manufacturing and production costs between System Processing Units and the System Accessories and Support segments;
- Labor and overhead per dollar of material assembled and per parts assembled;
- Major operating expenses and variances;
- Actual cost versus standard cost for the Touchscreen and Vectra.

Quality Data:

- Moving 15-month total of defects per million parts assembled, including causes and steps taken to remedy;
- Burn-in test results;
- Monthly average linearity.

Inventory Data:

- Worldwide inventory (consolidated, factory, and distribution centers);
- World-wide days of supply;
- POD Sunnyvale inventory (total, days of supply, and split between System Processing Units and the System Accessories and Support);
- Inventory transactions (number of ICS cashing transactions);
- Inventory integrity (adjustments made to reconcile monthly physical WIP inventory count and stores cycle adjustments).

Other:

- Purchasing metrics (number of vendors, number of part numbers);
- Safety metrics.

ISSUES FOR FURTHER CONSIDERATION

Given the nature of field or case studies, it seems inevitable, and perhaps desirable, that different readers will draw somewhat different conclusions from the same set of observations. This might be expected when no hypotheses are formally tested and no large data bases are available. Nonetheless, the hope of stimulating the formulation of hypotheses for further study was the primary impetus for this project. Discussed below are three broad areas where further studies involving both formal modeling and systematic data collection may be warranted.

Relation Between Cost Accounting and Quality Assurance

Except for providing the accounting department with the report shown in Figure 5, the Quality Assurance group saw itself as functionally separate from cost accounting, with a substantively different mission. Several persons in accounting, however, mentioned that they admired the gains that had been achieved by the Quality Assurance personnel, that the quality measurements were important, and that it would not be surprising if they were to develop closer ties with the Quality Assurance group. The existing functional separation, nonetheless, was a long way from the textbook scenario in which the cost accounting measurements are the primary source of data on whether the production process is "in or out of control."

Moreover, there appeared to be two divergent trends with respect to level of detail. In the JIT environment, cost accounting was systematically withdrawing from the precise identification of individual units or batches. In a sense, it was reducing the fineness of its information structure. Unit products or batches no longer bore job cards or work orders on which specific work times and material usage were recorded. Rather, a much less finely detailed procedure measured costs by the *ex post* averaging of accumulated expenditures over produced units.

At the same time, the Quality Assurance information systems were reaching for ever-increasing fineness of detail through the FAST barcode-reading system, which explicitly identified and tracked individual units and even individual subassemblies within units. It was almost as if the Quality Assurance personnel were attaching their barcode strips and process test sheets in the space that the accountant had freed by removing his job card. Similarly, while the accounting group at POD still computed a labor efficiency variance (although the cost accountants at some other HP divisions had abandoned the practice), the computation compared the actual total *monthly* production to the target total for the month. Quality Assurance, on the other hand, computed a linearity statistic at the *hourly* level, to ask essentially the same question: "To what extent did the actual production rate deviate from standard?"[14]

These differences in fineness of detail also corresponded to the use of financial versus non-financial measures, and these two comparisons seemed to suggest the spectrum of decisions sketched in Figure 11. At one pole we found the Cost Accounting Group supplying product cost data in aggregate, financial terms.[15] At the other end was found the Quality Assurance Group monitoring the production process to assure operation at design specification. Their measurements involved detailed, physical, nonfinancial parameters such as flow rates and defect descriptions.

Two intermediate points involved the transformation of financial budgets into manufacturing reality: the design of the manufacturing process (including the product itself) and the design of an organization to support that process, both physically (e.g., material handling, maintenance) and administratively. At POD, these nodes were revisited often as both process control and product costing data indicated potential improvements in the process, the product, or the organization.[16] Both the interplay between financial and physical measures and the iterative nature of the design process make these two functions interesting candidates for future modeling and empirical investigation.

Distinction Between Fixed and Variable Costs

In various discussions with the cost accounting staff, the terms "fixed cost" and "variable cost" seldom were used. The relevant distinction seemed to be "controllable versus non-controllable" costs. This was not due, however, to JIT

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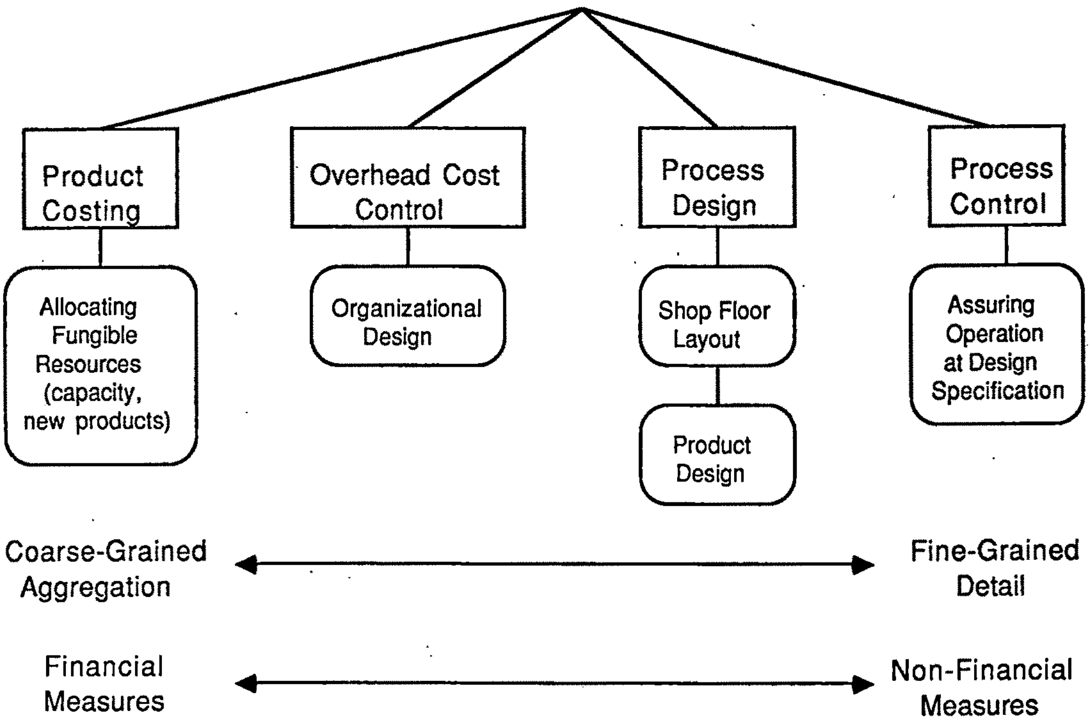
[14] However, the Quality Assurance department's measurement and interpretation process much more explicitly recognized the stochastic nature of the underlying process.

[15] Both characteristics, i.e., aggregate and financial, seem appropriate for decisions involving the allocation of capital (a fungible, financial resource) in capacity decisions, product entry or exit decisions, make or buy decisions, and pricing strategies.

[16] The virtually constant accessing of the COSTIT system was a prime example of this phenomenon.

FIGURE 11
USES OF MANUFACTURING AND COST ACCOUNTING DATA



changing the underlying cost structure to be either predominantly fixed or predominantly variable. It is true that direct labor expenditures became less variable in the traditional sense of a strict proportionality with output, but they were also small in relation to material costs, which became even more strictly proportional as quality assurance procedures reduced scrap and rework. Nor had the distinction between fixed and variable costs become hidden in the labor- and material-based overhead application rates, so that, for example, people were being fooled when COSTIT appeared to offer a large overhead saving from designing parts or labor out of a product. On the contrary, the cost accounting staff seemed to understand clearly how to interpret COSTIT's output and they felt that the design engineers also fully appreciated that overhead application rates changed as the bill of materials did.

What seemed to change were the relevant *action sets* and *time frames* within which costs could be controlled, regardless of whether they were fixed or variable. Because quality improvements had significantly reduced material losses on the line and because HP had a corporate policy of maintaining a stable labor force, relatively little more could be done to "control" variable costs on a day-by-day basis. On the other hand, fixed costs no longer were regarded as monolithic items that could be affected only by massive, "once-a-decade" changes in the physical plant. The relevance of the distinction between fixed and variable costs may have diminished because both were "controlled" by making incremental improvements in the product or the process and these sorts of changes could occur within a three- to nine-month period. For example, design changes that reduced the part number count from roughly 550 to 150 were conceived and implemented in less than a year, causing significant reductions in *both* variable manufacturing costs and fixed overhead required to inspect, store, and transport those parts. Continual quality control efforts were able to identify potential fixed and variable cost savings that required a change in the assembly process, and it was not unreasonable to rearrange the layout of the physical plant more than once a year to achieve them. Thus, the six-month planning and control period was one in which both fixed and variable costs could be reduced, and both often were reduced by the same process or product improvement.

This diminished role for the distinction between fixed and variable costs has been cited by other authors involved in recent field studies [e.g., Kaplan and Cooper, 1987]. The focus on a medium-term time frame and on the ability to alter both "variable" and "fixed" costs may present interesting modeling opportunities to accounting researchers.

JIT and Fluctuating Demand

When HP embarked on JIT production of the Touchscreen, it abandoned its "pure job shop, make-to-specific-customer-order" practices and pursued a "level production, make-to-stock-if-necessary" strategy. POD did encounter periods, at least at the outset, in which large inventories of finished goods accumulated at PCDO, so much so that on one occasion the excess had to be stored in vans in a parking lot. This awkward event highlighted the fact that while JIT methods greatly reduced raw materials and work-in-process inventories, the pursuit of a constant production rate implied that fluctuations in customer demand must be absorbed either by finished goods inventories or by marketing responses (e.g., pricing or promotions to move excess inventories, placation of customers whose orders are backlogged).[17]

The ultimate questions, of course, involve the issues of who will bear the costs of variability in demand, how those costs can be reduced, and how the variability itself is affected both by production performance and by marketing policy. POD was freezing its production schedule four weeks in advance on the basis of its own demand forecasts. Under the passive labor vouchering system, deviations of the build rate from schedule that were caused by changed market forecasts (rather than production problems) were classified as a labor efficiency variance, although the underlying cause could be identified correctly in the monthly cost accounting report. Use of JIT clearly increased both the value of accurate market forecasts over the three- to six-month horizon in which corrective capacity decisions could be implemented and the value of marketing techniques that would smooth customer demand.

CONCLUDING COMMENTS

Cost accounting procedures at POD changed; they were simplified and streamlined as they evolved toward process costing. One could sense a critical and continual evaluation of the costs and benefits of various levels of data aggregation. Similarly, more effort was being directed to understanding the causal structure of indirect manufacturing costs. However, the most interesting questions and insights to emerge from this study concern the interplay between cost accounting and production (especially quality control), in both the design and the operational phases. While most cost accounting texts warn the reader that traditional product costing reports are not the sole source of useful measurements, nor are inventory costing and income determination the sole uses, little research is available to flesh out our understanding of the alternatives. Detailed observation of actual manufacturing installations may help one to represent the quality assurance and product/process design functions in models that clearly identify the essence of these decision processes.[18] The challenge lies in capturing the special characteristics of these engineering functions while retaining a level of generality that will encompass a wide variety of manufacturing environments and thus allow accounting researchers to better understand the fast-changing world in which today's manufacturing firms function.

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[17] Large finished goods inventories do not necessarily conflict with JIT's emphasis on quality, so long as no degradation can occur once the product has been sealed in its shipping container.

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[18] One can envision analyses that run the gamut from the abstract information structures of Hurwicz [1972] or Demski [1980] to introspective behavioral analyses such as those described by Ashton [1982] or Moriarity and Joyce [1984] that examine individuals' personal information processing methods.

APPENDIX

GLOSSARY OF TERMS

BICS	Barcoding Inventory Control System.
CEDAC	Cause and Effect Diagram with the Addition of Cards.
COSACS2	Software modules that supported the inventory valuation process; e.g., standard cost and variance computation routines.
COSTIT	Computer software package that estimated the standard cost of the microcomputer product as parts were added, deleted, or modified in prospective design changes.
EDC	Engineering Data Control: a set of software modules that maintained the physical specification (e.g., bill of materials) of the microcomputer products; see Figure 6.
FA&T	Final Assembly and Test.
FAST	Failure Analysis Shopfloor Tracking System.
FGI	Finished Goods Inventory.
HEART	Computer program residing at Corporate Headquarters that maintained the sales order system.
HP	The Hewlett-Packard Company of Palo Alto, California.
ICS	Inventory Control System.
JIT	Just-In-Time.
LL	Lower Level (Work in Process Station): see Figure 9 for the context in which this term was used.
ORBIT	Order Requirement, Backlog, and Inventory Tracking System: software containing the perpetual finished goods inventory system.
PCA	Printed Circuit Board Assembly.
PCDO	Personal Computer Distribution Center.
POD	Personal Office Computer Division.
SACS	Sales and Cost of Sales System.
UL	Upper Level (Work in Process Station): see Figure 9 for the context in which this term was used.
WIP	Work-In-Process Inventory.

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BOOK REVIEWS

Richard P. Brief, Editor

Editor's Note: Books for review should be sent to Professor Richard P. Brief, 520 Tisch Hall, 40 W. 4th St., Schools of Business, New York University, New York, NY 10003.

AHMED BELKAOUI, *Handbook of Management Control Systems* (Westport, CT: Quorum Books, 1986, pp. xiv, 355, $49.95).

A handbook is typically intended to provide an up-to-date compendium of the state of the art. It is a book for practitioners to have on their shelves to refer to as needed. This book has a handbook-like goal—to present "the principal tools and techniques involved in the design and implementation of a management control system" (p. xiii)—but the author intends the book for use by first-year master's degree candidates and final-year undergraduate students, as well as practitioners.

The book starts, in chapter 1, with descriptions of a large number of control frameworks. While the individual descriptions are well done, the chapter does not discuss the frameworks critically nor attempt a meaningful integration of them.

Chapter 2 reviews the contingency research that relates aspects of management control systems with five categories of "independent" variables: technology, organization structure, managerial style, environment, and objective function. The chapter says little about the findings of research focused on other variables (e.g., corporate or business unit strategy, organizational interdependency, leadership style). The chapter also fails to consider relationships among the independent variables and their interactive effects on aspects of control systems. While discussion of the more complex relationships is difficult, it is necessary in order for practitioners to find the summary of literature worthwhile. The chapter concludes with a largely unrelated section on controllers' roles and characteristics of successful controllers.

Chapter 3 is on control of decentralized operations. It describes reasons for decentralizing and approaches to two measurement issues commonly faced in decentralized organizations: choices of measures of divisional performance (e.g., ROI, residual income) and transfer pricing. The chapter omits discussion of other important issues that could fit under this chapter heading. For example, when should responsibilities be divided into cost centers or profit centers when both are feasible? When should nonaccounting measures of performance be used/emphasized? How should incentive compensation plans be structured?

Chapter 4, on standard cost accounting, is primarily a technical discussion of variance analyses with little discussion of how the variance information should be used for control purposes. Other potentially important cost accounting issues are not addressed, such as when and why standard (as opposed to actual) cost systems are necessary or desirable for control purposes, how standards should be set, how cost accounting systems vary across settings (e.g., job shop, assembly operation, highly integrated, automated process), or how cost accounting information used for control purposes should vary from that prepared for other purposes (e.g., inventory valuation, product pricing).

Chapters 5 and 6 contain technical discussions of cost-variance investigation models and techniques for controlling projects (mostly PERT), respectively. Chapters 7 and 8 discuss control issues in special settings: multinational operations and nonprofit organizations.

The final chapter, on behavioral issues in control, discusses cognitive biases and manipulation of data and control. Other control issues that have been the focus of considerable behavioral research, such as the effects of participative budgeting processes on motivation, role ambiguity, and job tension in various settings, are not discussed.

In my judgment, the book does not meet the handbook aim of providing a comprehensive management-control-systems reference for practitioners. The book lacks an organized, integrated approach to management control systems, and no rationale is presented for the inclusion of topics nor the organization of the presentation. Many of the techniques discussed are used rarely (if at all) in practice (e.g., use of Chebyschev's inequality in investigations of the significance of variances). And the book jumps back and forth among discussions of control at varying levels of analysis: operations, projects, managers, divisions, and entire corporations.

Attempting to write such a handbook at this time was very ambitious. The field of management control systems is so broad that one book probably cannot cover all the topics adequately. Furthermore, our state of knowledge of how the key dimensions of control systems compensate for, reinforce, and interact with each other—and interact with any of the potentially relevant contextual factors—is very incomplete. Writing about what is not known, or couching research findings in cautious language, as is necessary, does not make good handbook reading for practitioners. Thus, while I think doctoral students will find some of the research summaries included in this book useful, I do not think the book will serve its intended constituencies well.

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MICHAEL BROMWICH and ANTHONY G. HOPWOOD, Editors, *Research and Current Issues in Management Accounting* (London: Pittman Publishing Limited, 1986, pp. 236, £19.95).

This book contains a collection of papers presented at the Fourth Deloitte Haskins and Sells' Accounting and Auditing Research Symposium held in September 1984 at the London Business School. The objective of the symposium was to provide an opportunity for academics and senior practitioners to discuss "the state of the art" in management accounting. The text is divided into five sections. The first, third, and fifth focus on research issues; the second and fourth discuss practice issues.

Readers who hope to garner new insights about developments in practice will be somewhat disappointed by the papers included in this volume. With the exception of the article by Michael Kirwan entitled "Management Accounting in Practice—A Consultant's View," the papers in sections two and four do not provide *new* insights. However, the other sections, which give an overview of the path of research, do provide some new ideas on where this path may lead in the future.

Introductory articles by Professors Anthony Hopwood and Charles Horngren set the stage. Professor Hopwood's overview discusses changes in the economic structures of organizations and information-technology that are causing practicing accountants to expand the possibilities for "designing, structuring and managing the information flows." He also discusses the reexamination process which management accounting research is currently experiencing. Professor Horngren, reflecting on his 32-year teaching career, concludes that early research focused on "better" practice whereas current research is focusing on foundations. He applauds moving away from the mentality of right or wrong procedures towards a framework which tries to explain existing practice.

Section three contains five papers by academics representing both British and American views on the state of research. A paper by Professor H. Thomas Johnson discusses the emerging role of the accounting historian in defining organizational aspects of management accounting. The paper by Professor Robert W. Scapens and Professor John Arnold outlines the considerable role that economics has had in shaping research. They point out that these economic theories were never intended to explain or predict the behavior of any individual firm even though researchers have attemped to use the theory to prescribe ideal management behavior. Unfortunately, many recent theoretical developments, such as agency theory, have retained a neoclassical outlook. In agency theory, "individual decision-makers are assumed to be rational economic persons who inhabit a world where the market mechanism can achieve an efficient allocation of resources" (p. 98). As such, the theory's value for explaining management's use of accounting will likely be at quite high levels of aggregation.

Professor Robert S. Kaplan repeats a common theme in criticizing current research. He states that "our existing stock of models do not capture contemporary phenomena which are critical to the success of companies" (p. 103). He cites recent developments such as MRP, total quality control, and flexible manufacturing as examples of these contemporary phenomena. Professor Kaplan urges an enrichment of our current models through field research.

Professors Jacob G. Birnberg and Kunal K. Sadhu tackle the difficult job of outlining the contribution of psychological and cognitive research. Unfortunately, they chose to concentrate only on published management accounting studies rather than discuss the stream of developments in cognitive psychology and the parallel developments in management accounting. The authors document that behavioral management accounting research is helping us understand what information is important to decision-makers, why it is important, and how it is used.

The final paper in this section, by Professor Jeremy F. Dent, discusses research on accounting's role in organizational processes and the impact of contextual factors on these processes. Professor Dent cites some comprehensive reviews of organizational research and then chooses to review only a few select issues. These include contingency theory approaches and qualitative process analyses. The paper concludes with a discussion of the implications for research in three areas: contingency theory, power in organizations, and accounting culture.

The book is concluded by Professor Michael Bromwich who attempts to synthesize the general themes presented and to identify areas for future research. All of the papers in this volume are worthwhile reading for those interested in acquiring an understanding of the evolution of management accounting research over the past forty years. They also provide insights about likely future directions. Perhaps one reason that management accounting was so narrow in the '50's and '60's was a lack of symposia like that reported here.

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R. J. CHAMBERS and G. W. DEAN, Editors, *Chambers on Accounting*, Accounting Thought and Practice Through the Years series (New York and London: Garland Publishing, Inc., 1986). Volume I: Accounting, Management and Finance, pp. 346, $35.00; Volume II: Accounting Practice and Education, pp. 384, $35.00; Volume III: Accounting Theory and Research, pp. 496, $55.00; Volume IV: Price Variation Accounting, pp. 333, $35.00; Volume V: Continuously Contemporary Accounting, pp. 507, $50.00.

These five volumes, exceeding 2,000 pages in all, offer a *selection* of the writings on accounting of Raymond J. Chambers. The papers included in the selection are mainly reprinted from academic and professional journals, with the addition of some unpublished lectures and seminar papers. Thus, Chambers' major work, *Accounting, Evaluation and Economic Behavior* (1966), in which he expounded his theory of Continuously Contemporary Accounting (latterly known as CoCoA), is not directly represented, although its ideas pervade all of his work.

Indeed, it is possible to consider most of the papers in these volumes as falling into one of three categories: the development of CoCoA, the exposition of CoCoA, and the defence of CoCoA (in some highly polemical papers). However, although this may sound rather narrow, and there is certainly plenty of repetition, a broad range of problems is addressed because CoCoA is the outcome of an ambitious attempt to reconstruct the whole of accounting theory, embracing everything from abstract methodology to practical applications of CoCoA in such specific areas as foreign currency translation. Moreover, Chambers' adversaries in his polemical exchanges (whether he is criticising them for not advocating CoCoA or they are criticising him for advocating CoCoA) include a wide range of the leading accounting theorists of the 1950s and '60s.

Perhaps, to the present-day reader, the least controversial and (possibly because they are less well-known) the most interesting papers are the early ones, written before 1962, when Chambers was developing the ideas which became the basis of CoCoA. His perceptive criticisms of conventional accounting practice, his insistence on a high standard of rigor in theoretical reasoning, his eclectic reading (including much early American accounting theory, but also philosophy and the history of science), and his insistence on the importance of education, mark him out as a distinctive contributor to the development of accounting thought and education during this period. These early papers are also of interest because they show the evolution of the intellectual foundations of the CoCoA system, e.g., the emphasis on the importance of the balance sheet, and the insistence that accounts should not anticipate future decisions although they should provide contemporary information relevant to such decisions. In 1961, this line of thought had led

Chambers (like Edwards and Bell) to advocate replacement prices in accounts, but, as is well known, he soon came to the view that exit prices rather than entry prices should be the basis of the CoCoA system.

While the early work establishes Chambers as an important contributor to accounting, it is the CoCoA system by which he will (and would wish to be) judged. His later writings are single-minded in their development and defence of this system. Some of the polemical exchanges with critics cannot be evaluated from these volumes because we are given only half of the conversation (Chambers' half). Furthermore, his major book is not represented, so that it is not possible to judge his work in its entirety. However, it is quite clear that CoCoA is, to say the least, a controversial subject. Chambers' complete rejection of entry prices in place of exit prices (which are regarded as "cash equivalents") is at the heart of the matter. This leads to such contentious issues as the view that non-vendible durables should be accorded a zero valuation, the advocacy of an apparently eccentric (to the reviewer at least) concept of DCEF (treating changes in "cash equivalents" as cash flows) in place of DCF investment appraisal, the controversies on the valuation of stock and fixed assets (e.g., as to the assumed rate of disposal), and the author's surprising insistence that long-term liabilities should be valued at face value rather than market value. These, and other controversies, are aired extensively, particularly in Volume V, and it is quite clear that Chambers has not persuaded many of his critics to his point of view, although he undoubtedly feels that he has defeated them in logic (if they are prepared to accept his assumptions). In a brief review, it would be inappropriate to attempt to pass judgment on these controversies, except perhaps to observe that they are marked by an unproductive degree of polarization.

Chambers' style of *a priori* theory is, of course, out of fashion at present. He rightly defends himself against the attack that his work is not "empirical" by referring to the considerable empirical observation which underlay the construction of his theory, much of which appears in *Securities and Obscurities* (1973) (reprinted by Garland in 1982 under the later title *Accounting in Disarray*). However, his empirical evidence tends to be piecemeal rather than statistical in nature and in this sense he is out of tune with the currently fashionable "positive" approach to accounting. Whether the *a priori* theorists of Chambers' type or the "positive" researchers will ultimately be seen to have made the greater contribution to accounting is a matter for posterity to decide, but it seems likely that Chambers' contribution to the development of accounting thought will be remembered as a significant one, and these five volumes will provide a permanent source of reference on the development of his ideas.

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LORETTA GRAZIANO, *Currency Fluctuations and the Perception of Corporate Performance* (New York; Westport, CT; and London: Quorum Books, 1986, pp. viii, 183, $35.00).

This book provides an accessible introduction to human information processing and applies human information processing to study a challenging problem in financial accounting. To achieve the stated objectives, the author investigates alternative (and hopefully more effective) forms of communicating foreign currency adjustment data to the traditional, unidimensional "right number" approach. The target audience is stated as being financial managers, controllers, treasurers, security analysts, and academics.

Eight chapters, a select bibliography, and a short index are provided. Chapter 1 considers the apparent confusion in the accounting profession about accounting for the impact of foreign exchange fluctuations. Chapter 2 reviews the evolution of relevant accounting standards and considers whether the problem can be solved by changing accounting numbers, accounting rules, or accounting rule-makers. Chapter 3 is concerned with communication theory as well as its importance and application to accounting and financial reporting. Chapter 4 examines the economics of exchange rate movements and Chapter 5 provides an introduction to the mechanics of human information processing. Integration of prior material takes place in Chapter 6, which applies human information processing insights to foreign exchange accounting data. Chapter 7 explores alternatives and additions to existing accounting data that offer the prospect of improving communications about foreign currency adjustments. Finally, Chapter 8 applies the cognitive view to communication problems in other economic and financial areas.

This book offers much to the reader who is prepared to take the time to fully digest its content. Historical and structural explanations for the roles of international currency, the FASB, and the SEC are provided in a clear and succinct manner. The explanations of exchange rate impacts are also well handled. The human information processing framework is comprehensively examined in its discussion of such dimensions as perception, selectivity, and memory and will be quite easily understood by the uninitiated. Chapter 6 provides a useful and critical comparison of the cognitive view of decoding currency adjustments and the efficient markets perspective.

In terms of proposed communication improvements in the foreign exchange accounting area, the author suggests a process of slow, incremental change with adjustments carefully targeted to bridge existing communication gaps. Possibilities include better labelling and prose form in footnotes and management analyses. The suggestions are not very dramatic or innovative but are, nonetheless, well argued and justified.

The style of writing is somewhat unusual. It often has a conversational style, accompanied by case examples, analogies, and vignettes involving (presumably) fictitious investment managers. It is therefore an eminently readable text that attracts and holds reader interest while discussing a highly technical subject area in a clear and effective manner. At the same time, it has some problems in overall presentation for all but the most serious reader. The text lacks an introduction that clearly lays down the book's objective, rationale, and plan of discussion. For instance, this reviewer deduced the objectives from the dustjacket, two sentences on p. viii of the preface, and a paragraph on p. 30. A brief chapter plan appears on p. 42 at the end of Chapter 3. Similarly, the text lacks a clear summary and conclusion. Indeed, most chapters would benefit greatly from a summary paragraph or two.

Overall, this book is a commendable piece of work. It brings a much needed and fresh approach to the problem of accounting for foreign currency translation and demonstrates a new area for the application of human information processing concepts in the accounting arena. For the concerned professional and accounting researcher who is prepared to study its contents carefully, it will provide a fascinating and rewarding experience.

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HOWARD H. GREENBAUM, Editor, *Management Auditing as a Regulatory Tool* (Westport, CT and London: Praegar Publishers, 1987, pp. xx, 346, $49.95).

Management auditing for public bodies is poised at a very interesting stage of development. It is also a very ambitious topic to tackle in the way Professor Greenbaum proposed. His research objectives were:

(1) to understand the current state of management audits in public utilities and
(2) to evaluate actual management audits performed to see whether they were adequate in terms of assessing organisational efficiency and effectiveness.

These objectives were pursued by getting eight MBA students to contribute a chapter each; the first three deal with management auditing in general and the last five chapters relate to management audits for specific functions. All audits examined were undertaken for New York state—eight of them by notable private sector consultants—and attempts were made to compare the audits with criteria for effective management auditing.

The resulting book gives a good picture of the current state of management auditing in terms of the general nature of the processes of investigation, but it fails, in any significant way, to assess the adequacy of the management auditing processes as a mechanism for evaluating *effectiveness.*

The book generally fails to achieve its second objective because there is no adequate consideration of how to evaluate the effectiveness-of-service provision. Certainly, limited reference is made to some literature on effectiveness, including the students' recognition of Greenbaum's own work, but the literature is referred to with minimal discussion and critical review, only considers a very small subset of the vast array of literature on the subject and, most importantly, misses completely the U.S. "evaluation literature." Granted, the latter does not reside in accounting or management journals, but more in areas concerned with the evaluation of education and social services, which are also not the services with which Greenbaum's case studies are concerned. Nevertheless, the evaluation literature is a rich source of information on different paradigms that may be used to conduct effectiveness evaluations and evaluate the evaluations themselves. Writers in accounting journals continue to overlook this source.

Unless one pursues the analysis of how to evaluate effectiveness in much more depth than is given in this book, it is difficult to see how one can conclude, as Greenbaum does, that "management auditing is an effective tool for determining the efficiency and *effectiveness* of public utility management systems" and "further, it was found that the audits completed in New York State during the period 1975–1981 were usually well-designed and properly conducted." What the latter means, in the context of Greenbaum's book, is that the audits were conducted according to very broad criteria and standards which, while necessary for ensuring "generally proper conduct," in no way offer guarantees that effectiveness of service delivery is evaluated rigorously.

Perhaps the statements above reflect too much the reviewer's disappointment with the book which, by its title and contents list, seemed to offer the prospect of satisfying some of the reviewer's own needs. The book *does* show clearly the current state of the art and *does* suggest some improvements in practice. The discussion in relation to some of these proposals often, however, has a tendency to general assertion rather than argument. For example, on methods one conclusion states that the failure to employ these analytical techniques (queueing, network analysis, linear programming, etc.) limits the ability of the auditor to identify areas of concern and the value of the recommendations rendered. Another states that the number of interviews should be reduced on a selective basis to save time and money. Yet another states that consultants should use questionnaires to gather more facts at a reasonable cost. Perhaps all these conclusions are correct, but if so, they need to be justified by reference to what is needed for a rigorous evaluation of effectiveness in each specific situation. This level of insight is not offered to the reader even though specific cases are examined.

In summary, the book misses a good opportunity to offer a radical challenge to the fundamental concepts of evaluating effectiveness. Moreover, this was needed to deal properly with the book's second objective. This was too much to expect from a few MBA students with, presumably, limited time to reflect on the more fundamental issues at stake. It is also quite clear, as Greenbaum honestly admits in his acknowledgments, that the MBA students were "unaware of the severe strains of quality authorship" and there was a need for "countless rewrites." The end product is in a style which often resorts to check-lists of what was done and what needs to be done, rather than an appraisal of the quality with which the consultants' investigations were performed. This suggests that the countless rewrites have contributed to a reduction of data to such an extent that it only appears in summary form. By returning to the data, Greenbaum himself, rather than the MBA students, should be able to give us richer insights into the question of effectiveness in what would then be a set of very useful and welcome case studies. Pending that, the book is, nevertheless, a useful library acquisition to reflect the state of the art, although this reviewer wishes to reserve judgment on the extent to which the work actually conducted by consultants really is satisfactory in evaluating effectiveness.

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DAVID HALBERSTAM, *The Reckoning* (New York: William Morrow and Company, Inc., 1986, pp. 752, $19.95).

You may wonder why a book that deals with the second largest auto company in the United States (Ford) and its counterpart in Japan (Nissan) is reviewed in THE ACCOUNTING REVIEW. In fact, you may ask whether automobile manufacturing has anything to do with accounting at all. In this book, Halberstam does a masterful job of not only showing how accounting and the manufacture of automobiles are related, but also how the misuse of accounting data at Ford is a symptom of far greater ills in American industry.

The book begins with an interesting description of the early beginnings of both companies; the author develops a part of the history of one company for a number of chapters and then shifts attention to the other company. This alternating style allows the reader to see how the management styles of the two companies differed and how certain management practices evolved. For example, quality circles were developed at Nissan as a response to severe labor problems. Management thought that periodic discussions among workers might reduce the worker unrest. And at the Ford Motor Company, Henry Ford disliked accountants so intensely that he would periodically walk into the accounting department and fire everyone in the room. Needless to say, this did create severe problems for the company.

Henry Ford was a management genius who created an enormous empire by continually seeking more efficient ways of producing cars. However, his stubbornness and resistance to new ideas almost destroyed the company, and Halberstam suggests that only the onset of the Second

World War saved the company from Henry Ford's irascibility. Near the end of his reign Henry Ford ruled his empire with fear and muscle. Workers could be fired on a whim, and foremen were hired for their ability to intimidate workers instead of their knowledge of manufacturing procedures.

Nissan was no paradise, either, in its early days. The company teetered on the brink of bankruptcy immediately following the end of World War II, and the workers were dominated by a charismatic communist union leader who sought to run the company as his own fiefdom. Supervisors who did not cooperate with the union were subjected to brutal forms of psychological abuse, and ultimately either caved in to the intimidation or left the company. Nissan management ultimately broke the union with a plant lockout, the use of thugs, cooperation from other manufacturers, and the development of a rival company union.

The political struggles that occurred at the two companies make for interesting reading. Sometimes the book reads more like a description of medieval palace intrigue than a narrative of happenings at the highest levels of corporate management in major businesses. Both companies had a variety of factions and personalities competing for power at various times. Of course, most readers are already aware of the personalities of Henry Ford II and Lee Iacocca, but these are just two of the more colorful individuals who play a role in the story.

Even the accountants were political. When Henry Ford II took over the Ford Motor Company, the accounting system was in such a shambles that accountants paid vendors by measuring the height of stacks of invoices and then paying vendors on the basis of estimated dollar amount of payables per foot. Clearly no company could operate with such an accounting mess, and Ford hired people to create an accounting system. They were very successful, and soon Ford relied on the accountants to tell him what was really going on in the company. However, the accountants created their own empire.

Plant accountants reported to Ford headquarters in Detroit and not to the plant managers for the plants in which they worked. Accountants moved in circles apart from the operating people, and the surest way to kill a promising accounting career at Ford was to get too friendly with the operating people. Accountants spoke to accountants and to Henry Ford, and their job was to see that the company functioned properly. MBAs were hired from the best schools to work in accounting, and their entire career was spent in accounting. These accountants would prepare detailed questions for operating managers to answer at monthly meetings, and no project ever got approved if the accountants did not like the analysis that supported the project. As a result, the accounting information came to drive the company, and managers spent more time playing games with the accounting numbers than they did managing operations. The results are obvious.

Meanwhile, at Nissan, accountants hardly seemed to play any significant role at all in the company operations. The critical people, according to Halberstam, were the engineers. Jobs for engineers were scarce after World War II, so many of them took factory jobs. This placed engineering talent directly on the factory floor where it could be used to solve manufacturing problems directly and speedily. Furthermore, the Japanese workers were accustomed to hardship, so they would work long hours for low pay and be grateful just to have a job.

Accountants are definitely not the heroes of this book. Halberstam outlines many of the problems companies create by relying too much on data in accounting reports. Furthermore, he implies that many of the problems facing American manufacturers are due to managers focusing too much on the accounting numbers instead of on the actual operations themselves. Perhaps the message in the book for accountants is that management accounting should get in touch with operations and focus on the linkages with management problems instead of operating in a world untouched by the problems of plant floor management.

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H. THOMAS JOHNSON and ROBERT S. KAPLAN, *Relevance Lost* (Boston: Harvard Business School Press, 1987, pp. xiii, 269, $19.95).

By combining, in a book of reasonable length, a review of the development of management accounting through almost two centuries with a critique of where management accountants stand today and some pointers as to where they should go tomorrow, Professors Johnson and Kaplan have put students and practitioners of management accounting in their debt. No one could read this book without taking away some new insights. At the same time, readers may, like me, want to argue with the authors on some points, and preserve a degree of skepticism on others. The very title of the book, and especially its subtitle, gives warning of its sometimes evangelistic tone. This is no mere scholarly treatise. The authors have a message.

They look back to the period 1880–1925 (roughly) as the golden age of management accounting. In the earlier part of that period, cost accounting was largely the province of engineers, and its primary concern was process control and product costing. The later part saw the rise of giant corporations like Du Pont and General Motors. These corporations did not simply grow laterally. They integrated forwards and backwards, and thus brought *within* the firm many transactions that had previously been conducted in the market. The diversification and decentralization that accompanied this development called for new measures of performance such as ROI, and new methods of control, or the extension of old ones, such as budgets. Here J&K draw liberally on the work of Alfred D. Chandler and Alfred P. Sloan.

But somewhere along the line, management accounting, and especially cost accounting, was subverted to serve the ends of external financial reporting and of auditors. The authors come back to this point again and again. Thus: "engineer-managers in metal-working firms between 1880 and 1910 had developed procedures for computing managerially relevant product costs. But those procedures disappeared from manufacturing accounting practice and writing after 1914. In their place appeared the costing procedures that twentieth-century accountants developed to value inventories for financial reports" (p. 126). On p. 156, "Cost accounting had already [they are here discussing J. M. Clark's *Economics of Overhead Costs*, published in 1923] become subservient to the goals of external reporting and only occasionally emerged to aid managerial decisions and control." On p. 228, after listing four different functions of a cost system, they say: "The first of these objectives, to accumulate period expenditures and then to divide them between cost of goods sold and inventory in an objective, consistent, and verifiable manner, has driven the practice of cost accounting throughout this century. . . ."

Considering the importance that Johnson and Kaplan attach to this assertion—I could have quoted several more passages similar to the ones above—they bring forward remarkably little evidence to substantiate it, or, if it is true, to explain it. I do not recall that the costing textbooks that I studied 50 years ago, whose ideas were rooted in the two decades before that, were tainted by subservience to the needs of auditors, though they were certainly tainted in other ways. In Britain during World War I, cost accountants had been called upon to work on cost determination (of specific products) for government procurement purposes as never before. External reporting had little to do with that.

The third edition of the *Cost Accountants' Handbook*, edited by Theodore Lang (Ronald Press, 1945), an authoritative compendium written for working cost accountants, not for academics, listed (on p. 222) the objectives of cost accounting as:

1. To control expenditure
2. To price products
3. To provide basis for operating policy

There is not a word here about external reporting. In a list of seven advantages of cost accounting on p. 224 of the *Handbook*, only the fourth referred to "presentation of more frequent and more accurate financial statements." There is nothing in the list that J&K could find objectionable.

It never becomes clear what mysterious forces are supposed to have led to the corruption of management accounting, but certainly academics do not escape censure. "Academic cost accountants, more than auditors or managers, may have contributed to accounting's lost relevance for cost management, especially since World War II" (p. 145). They did this, it is argued, by using an excessively simple model of the firm in which "inventory cost information" was recast to solve contrived production problems. Academic accountants can indeed be criticized for using an overly simple model of the firm (about which more later), but I do not believe that the demands of external reporting have much to do with it.

Nor do I believe that there is any basis for the charge against academic cost accountants that in their teaching and writing they have oversimplified the two-stage process by which overhead costs are first allocated to cost centers and then, by means of cost center rates, to products. J&K say (on p. 192): "the academic examples, dealing with only one to three products at a time, never see the need for this two-stage allocation process. Since it is not considered, it is not studied or taught. Thus, perhaps the most important feature of how overhead costs are allocated to products is absent from virtually all textbooks, teaching, and research." This is a remarkable statement. As I recall, cost accounting textbooks have described the use of departmental or cost center rates to apply overheads to products. The recent 6th edition of *Cost Accounting* (Prentice-Hall, Inc., 1987), by Charles T. Horngren and George Foster, devotes two separate chapters (12 and 13) respectively to "the allocation of indirect costs to departments producing products or services" and to "the allocation of indirect department costs to the individual products or services themselves" (H&F, p. 415). This treatment could be found in earlier editions and in many other textbooks, in varying degrees of detail.

Textbook writers have indeed been at fault in discussing manufacturing situations in terms of one or two products and one or at most two processes. Of course, this enables them to minimize complexity; but it also sacrifices realism. This is particularly serious in discussions of standard costing. One of the principal virtues of standard costing is that, in considering variances, it focuses on processes, not products. As there are usually far fewer processes than products in real life, the emphasis on processes greatly reduces the number of control figures that a manager must attend to. But in using a simple model with only one process, as textbooks (even good ones) usually do, this point gets lost.

Johnson and Kaplan are on firm ground when they anathematize two of their favorite *bêtes noires*, the tendency for performance measures to encourage short-sighted managerial behavior and the continued widespread use of direct labor as a basis for applying overhead expense to products.

On management myopia, until we can find some way to reflect, in our measurement of profit, the creation and growth of such intangible assets as customer goodwill, employee morale, and slow-to-mature innovativeness, income statements will not satisfactorily reflect long-run management performance. J&K recommend attacking this problem by the use of nonfinancial indicators of such matters as the incidence of scrap and rework, customer complaints, productivity, average day's production in inventory, and so on.

In the formative years of cost accounting, at the end of the last century and the beginning of this one, the distinction between direct and indirect costs, and the use of direct labor as a common base for charging indirect costs to products, made a lot of sense. But we have clung to these methods for too long. As production has become more automated, the distinctions between labor and other costs, between direct and indirect costs, and even between fixed and variable costs, have been eroded. The result has been to load products that may have a minuscule labor content with a mountain of indirect cost. Labor content has long ceased to be a satisfactory basis for allocating all but a few items of overhead. J&K do well to emphasize the need for more sophisticated costing methods that can have due regard for such cost determinants as machine time, the number and complexity of set-ups, the number of transactions involved in handling small-volume products and small orders, and other phenomena associated with what Peter Drucker called "product clutter."

Relevance Lost would have gained in relevance if less space had been devoted to factory operations and more to the marketing and distribution functions and to service industries generally. These matters are not ignored; but the allocation of space lags badly behind the change in the balance of our economy between goods and services. All books on costing, virtually without exception, continue to suffer from this lag. The new edition of Horngren and Foster continues this bad tradition.

In spite of its defects, this book would be a valuable addition to any management accountant's library. It is trenchant and thought-provoking. We could do with more such books in our field.

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WILLIAM R. KINNEY, JR., Editor, *Fifty Years of Statistical Auditing*, Accounting Thought and Practice Through the Years series (New York and London: Garland Publishing, Inc., 1986, pp. 169, $20.00).

In a rapidly changing profession, historical perspectives are often lost in the rush of progress. A retrospective of this type is particularly appropriate in that we seem to have reached a practical, if not theoretic, plateau in the area of statistical auditing.

The 15 articles included in this volume are interesting and revealing. Some of the readers may not recognize the very early authors: Carman (1933), Prytherch (1942), and Cranstoun (1948). However, the remaining articles were by writers who are still major players in the area of auditing and statistical sampling: Neter (1949 and 1974), Vance (1951), Stringer (1961, 1963, 1972, and 1975), Brown (1962), Elliott and Rogers

(1972), Kaplan (1973), Cushing (1974), Goodfellow, Loebbecke, and Neter (1974), and Kinney (1975).

The period from 1933 to 1961 includes six of the 15 articles and represents the birth and tentative growth of statistical sampling in auditing. By 1961, the efficacy of statistical sampling in certain areas of audit practice was generally accepted. The next five articles cover 12 years of growth in our understanding of both the utility of statistical sampling in auditing and the problems encountered in application. Kaplan's article, published in 1973, neatly closes this period by detailing the statistical problems associated with variables sampling techniques.

These 11 articles have a distinctly attribute-sampling orientation. Perhaps, with hindsight, the attribute orientation is appropriate. It seems to lead us almost naturally to the Dollar Unit Sampling literature included among the last set of articles. Dollar Unit Sampling has dominated auditing applications in recent years. In fact, read in the light of current practice, some of the earliest articles now have a faintly DUS sound to them.

In addition to the classical statistical sampling methods, several articles use probability concepts in evaluating and/or relating internal control to tests of details and substantive tests, and one article is based on information economics and Bayesian statistical concepts.

Selecting a set of articles to represent the historical development of an area like statistical sampling in auditing is not an easy task, and it is natural to ask whether other work might have been included. Although I was initially surprised not to see some of the names associated with early developments in the field like Arkin [1961], Birnberg [1964], Ijiri and Kaplan [1970], Smith [1972], and Tracy [1969], after further consideration, it is clear that the selection was very astute and that most of the included articles are seminal pieces representing the first published references to particular statistical concepts in auditing.

Several less positive matters warrant comment. First, the introduction to this volume is only five pages and I would have liked to have seen more. Kinney is one of the most knowledgeable and insightful students of statistical sampling in auditing and his analysis might have been expanded. For example, there is an interesting evolution in the terminology concerning fraud, shading to much more careful distinctions as the articles progress through the years. The second point concerns the quality of production, which is poor by today's standards. The publisher has simply reproduced the articles by photocopying from the original sources; and in two cases some extraneous material (about one page in all) has been reproduced. These are minor shortcomings.

The book is a useful addition to auditing literature and I am pleased to have had the opportunity to have read it. *Fifty Years of Statistical Auditing* is recommended both to practitioners and researchers interested in the way that the field has developed and its prospects for the future.

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LEE D. PARKER, *Developing Control Concepts in the 20th Century*, Accounting Thought and Practice Through the Years series (New York and London: Garland Publishing, 1986, pp. ix, 324, $30.00).

This book is a revised version of the author's Ph.D. thesis which helps explain its shift from a discussion of the historical development of control concepts in the management and accounting literatures to a quantitative analysis of pages, articles, or standards devoted to control concepts in accounting.

The author's primary purpose was to identify the conceptual characteristics that have been attributed to the term control as it has been used in the literature on management and accounting in the twentieth century. This is accomplished by examining the progression of conceptual ideas concerning the nature of control in management and accounting literatures during the 1900–1979 period. The author follows the management literature starting with the classical model developed by blending together Taylor and Fayol's work, proceeding to the development of structural and behavioral models influenced by Follett's contributions, and concluding with systems models in the 1970s. The accounting literature is followed through the classical model, to a focus on controls rather than control concepts, and finally to the beginnings of a behavioral model and a systems model, both coexisting with the classical model.

The author attempts to identify key concepts of control in the context of schools of thought from which they appear to have been developed. He includes a discussion of the socio-economic conditions prevailing during the time the concepts were developed as well as a description of personal characteristics of some of the key originators of control ideas. The author then uses relationships between control concepts to develop models of control that he believed existed at different points in time in management and accounting literatures.

The author performs this historical analysis to compare the paths of control concept development taken by management and accounting. He is specifically interested in whether they developed control concepts in isolation, whether one predated the other, and whether the models have the same level of complexity and variety of concepts. This is the area where the book begins to decrease in interest and relevance. The analysis performed by the author is very dependent upon literature surveyed (described in detail in Chapter 1), classification of authors as management or accounting, perception of what constitutes control concepts versus tools, etc. His quantitative data consist of such items as earliest date a control concept appeared in management versus accounting literature, the percent of accounting journal articles devoted to control, the percent of accounting textbook pages devoted to control concepts versus tools, the number of external reporting standards that discuss control concepts, etc.

Accounting students and academics interested in the historical development of control concepts in accounting and management should benefit from reading the first six chapters of the text. The remaining three chapters, which contain the quantitative comparative analysis between developments in accounting and management literatures, would have been best left in the Ph.D. thesis.

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R. H. PARKER, G. C. HARCOURT, and G. WHITTINGTON, Editors, *Readings in the Concept and Measurement of Income*, Second Edition (Oxford: Philip Allan Publishers Ltd., distributed in the U.S.A. and Canada by Humanities Press, Atlantic Highlands, New Jersey, 1986, pp. vii, 371, $55.00).

The stated purpose of this collection of readings is "to bring together some important writings on the concept and measurement of income, drawing from both the economic and accounting literature" (p. 1). Nineteen selections are included, ten of which have been retained from the 1969 first edition. The age distribution of the selected pieces is interesting—eight (all by economists) are more than 40 years old, three date from the 1950s and 1960s, and eight come from the inflation accounting literature of the 1970s. The 1980s are represented only by a few brief "postscripts" to earlier papers. A useful and unusual feature (for a book of readings) is the contribution of 42 pages of overview, analysis, and discussion by the editors, in the form of "Introductions" to both first and second editions. While the editors acknowledge that there is no unique "true" concept of income, their bias is towards a model which incorporates both deprival values and general price index adjustments. This permits the calculation of several income numbers that they would report in a multi-stage income statement.

The readings are grouped into three sections. Section I, "Concepts of Income in Economic Theory," contains J. R. Hicks' classic explication of personal income as "well-offness," essays by Irving Fisher (income as consumption) and Erik Lindahl (income as interest), and critical reviews of various economic concepts by N. Kaldor and H. C. Simons. Of particular merit is the Kaldor piece. Its scope and competence are such that it could almost stand in place of the whole section.

Accountants have tended to look to the discipline of economics for concepts of income that will prove viable in the construction of accounting theory. In particular, Hicks' concept (in one of its several constructions) has been much quoted in the accounting literature as a measurement ideal; often, one suspects, without having read Hicks in the original. It is therefore useful to have the original readily accessible in a book of readings, not least because Hicks' own evaluation of the income concept as an analytical and operational tool is so strongly negative. The other readings in section I, and those of section II, "Income and the Maintenance of Capital Intact," provide an interesting commentary on the problems that have frustrated economists' attempts to define and measure income. As Simons observes (pp. 94–95):

> Economists . . . have done almost everything with the income concept except to give it such definition as would make it eligible to a place among our analytical tools.

There is a lesson here for accountants. It may fairly be doubted whether economists' concepts provide fertile soil in which to root accounting income measures. This lesson (though possibly not the one intended by the editors) is reason enough for accountants to absorb these readings, which indeed distinguish the book from other collections of readings pertinent to an accounting audience.

David Solomons' well-known comparison of economic and accounting concepts of income opens section III, "Measurement of Business Income," thus providing a link with the earlier sections. Nine additional selections (including some authored by economists) present a cross-section of views on income measurement from the accounting literature (eight from the 1970s; one from the 1960s). Current entry values are featured prominently, but in a variety of contexts —e.g., in both replacement cost and deprival value models, and in conjunction with both physical and financial capital maintenance. Different authors present conflicting views on the validity and desirability of general price index adjustments in accounts, on the legitimacy and value of subjective economic income concepts as goals of accounting measurement, and on other matters. The contributors include both authors of the classic Edwards and Bell book (Bell's paper being co-authored with L. T. Johnston). Exit value is represented by R. J. Chambers' "Second Thoughts" article (with a 1984 "Addendum"). W. T. Baxter's excellent critique of Chambers' first thoughts on the subject is also included.

One of the most interesting papers (and the least accessible from an alternative source) is by Oxford economist M. FG. Scott. Among other important insights, he recognizes the "irrelevance" of a physical capital maintenance concept in the face of non-identical replacement and technological change (a fact to which the authors of some other selections seem oblivious), and the propriety of charging historical cost rather than current cost in calculating operating profit when, as a matter of policy, cost increases are not permitted to affect selling prices until incurred. Unfortunately, Scott's zeal for "standard stream income" leads him to extremes of income smoothing—even a constant purchasing power adjustment is based on an estimated *average* rate of inflation over several years—and an accounting system overburdened with assumptions, estimates, and notional amounts.

Conspicuously absent from the book is any representation of agency theory. Thus, an important source of rational explanation for the survival power of GAAP-based income reporting is disregarded. Nor, for that matter, is there any defense of historical cost, such as one finds, for example, in Yuji Ijiri's elegant arguments. Agency perhaps explains why Solomons' pessimistic expectation that the 25 years commencing in 1960 might turn out to be "the twilight of income measurement" (p. 166) is in retrospect unfounded. En route to this conjecture, Solomons notes that "the question which accounting income palpably fails to answer" is: "How much better off has the accounting entity become during the period?" (p. 159). If accounting income calculations are guided by agency considerations, this, of course, is the wrong question, or at least not the only important one.

Section III does include a paper by William H. Beaver and Joel S. Demski which touches on the agency perspective. However, their important "basic point" is somewhat different—namely, that "choice of an income rule cannot be resolved by applying fundamental measurement arguments" (p. 176) (an observation which challenges many of the claims made in other papers included in this volume). Rather, income measurement is a "noisy but cost effective communication process." The editors endorse this view in the context of the user decision-making orientation of accounting which pervades the selected readings, and which is, of course, the philosophy embedded in the FASB's Conceptual Framework. However, the agency perspective also deserves recognition, given the increasing attention paid to it in the literature. It is even possible to view the user decision and agency perspectives as complementary rather than mutually exclusive.

The editors commend the book to "a wide audience" (p. 2). However, given the age distribution, content, and interdisciplinary mix of the readings, this volume is likely to be of interest mainly to students of the evolution of economic and accounting thought, and more especially to those with a strong interdisciplinary interest in the two fields. Even so, it will be found that economic and accounting concepts of income relate as associates rather than kin. For example, the editors correctly describe a group of five papers by economists as having "no particular concern with accounting or the measurement of business income" (p. 3). The book should also be useful as supplementary reading in a graduate or senior-level accounting theory course, but the price of $55 might dictate recommended rather than required status.

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ALFRED RAPPAPORT, *Creating Shareholder Value* (New York and London: The Free Press and Collier Macmillan Publishers, 1986, pp. xv, 270, $23.95).

Professor Rappaport has produced an interesting book, broad in scope, which integrates ideas taken from finance, accounting, economics, and strategic management. There are two central themes of the book. First, it is argued that accounting targets, such as growth in earnings per share or accounting rates of return, potentially mislead management into making decisions and adopting business strategies that are non-optimal from the point of view of creating shareholder value. Second, the present focus of attention on discounted cash flow analyses should be enlarged from individual capital investments to the assessment of alternative business strategies at both the corporate and individual business unit levels. The book builds on ideas derived from Michael Porter's book, *Competitive Strategy* (New York: Free Press, 1980), and demonstrates a framework of evaluation for how these ideas can be analyzed from the point of view of the creation of shareholder value.

The book is laid out as follows. Chapter 1 provides a justification for the use of the shareholder value approach as the best means of achieving the traditional corporate goals of maximizing shareholder wealth and, hence, serves as an introduction to the book. Chapters 2 and 3, which form Part I of the book, are concerned with the shortcomings of accounting numbers as indicators of the ability to create shareholder value and the applicability of discounted cash flow techniques to alternative business strategies, respectively. In addition, Chapter 3 introduces what Professor Rappaport refers to as *value drivers*, that is, those parameters that drive the cash flow performance of a corporation and that, hence, are central concerns of shareholder value-creating business strategies. These include growth in sales, operating profit margin, and incremental investment rates in fixed and working capital investment.

Part II of the book, encompassing Chapters 4 through 7, is concerned with linking Porter's ideas with the shareholder value approach at both conceptual and practical levels. Thus, Chapter 4 covers the link conceptually, with Chapter 5 illustrating practical applications of the approach. Chapter 6 is concerned with the financial feasibility of alternative business strategies while Chapter 7 points out what share prices tell about market expectations and hence what relationship might be expected between the adoption of business strategies consistent with the shareholder value approach and the performance of a company's shares in the market.

Part III (Chapters 8 and 9) of the book considers some specific additional issues. Chapter 8 is concerned with how to evaluate performance and appropriately develop executive compensation schemes. The point is made that unless performance evaluation and executive compensation are tied to the creation of shareholder value, the value of any planning process based on the creation of shareholder value will be lost. The chapter contains practical suggestions as to the use of the value drivers that underlie the creation of shareholder value in the evaluation and reward process. Chapter 9, the final chapter of the book, deals with the analyses of mergers and acquisitions from strategic and value-creation points of view. It includes a case study of the Quaker Oats acquisition of Stokely-Van Camp to illustrate the application of Professor Rappaport's approach to an actual acquisition.

A criticism of the book might be that it aims to achieve too much, given its length. By attempting to integrate ideas from various academic disciplines in a relatively small number of pages, some of these ideas are not really explained enough, especially in terms of the limitations of the analysis techniques employed. For example, such a criticism applies to the use of the capital asset pricing model in a multiperiod setting, a central issue in the use of net present value techniques in an uncertain environment. A further criticism, although minor, is that some terminology used might be confusing to readers acquainted with the use of similar terminology in different settings. Such a criticism would apply to the use of the term "cash flow from operations" which, in the book, has a different meaning from a similar term, "cash provided by operations," employed in GAAP-prepared statements of changes in financial position using a cash basis.

Some of the above "problems" possibly arise because the book is targeted at an executive audience. Such an audience might not have time for academic niceties. The targeting of the book might restrict its usefulness as a textbook, at either the undergraduate or MBA levels, although one could imagine its use for senior-level undergraduate or second-year MBA strategic management electives. Overall, the book is interesting to read, if somewhat "breathless" at times, but should certainly represent a stimulating addition to executive bookshelves.

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GOKUL SINHA, *Accounting Theory* (Calcutta: Book World, 1986, pp. iv, 299).

This book follows what has over the years emerged as the conventional pattern of those with the title of *Accounting Theory*. Consequently, it can be reviewed on two levels—a general critique of that pattern and a specific assessment of the quality of argument presented in this particular book.

The book opens with a chapter on general methodological issues on the nature and functions of theory, a definition of accounting, and the relationship between the two. The next chapter presents a historical sketch of accounting and is followed by chapters devoted to various arguments in the literature concerning the central notions of traditional financial accounting—capital, income, asset valuation, and the problems of price-level accounting. A "speculative" issue (human resource accounting) is discussed in the last chapter.

The major criticism of accounting theory texts of this conventional pattern is that they do not present any novel accounting theory themselves. Rather they provide synopses of dominant themes in the literature and leave the student (reader) to decide which alternative is best or, worse still, to accept *all* as equally acceptable rationalisations of very different courses of action. This approach, when used as a teaching technique, rather than leaving the student with an open, critical mind, encourages the belief that accounting is an ill-defined discipline such that so long as the "story is good enough," any action can be justified.

The ontological and epistemological assumptions in the first chapter of the book are extremely conventional. There exists an objective reality, the explanation of which is the function of theory. The formulation of theories is claimed to be along strict positivist lines and the book perpetuates the artificial distinction between normative and descriptive theories. The definition of accountancy (p. 5) is so convoluted and general as to permit almost any human activity to be described as part of it. This creates obvious difficulties for the author when he attempts to relate the discussion of theory to accountancy (*sic*) and there are inconsistencies. For example, after presenting five good reasons for not accepting conventional accounting rules and procedures as theory (pp. 8–9), more than half the first chapter is devoted to describing "the doctrines" (e.g., materiality, objectivity, disclosure) and "assumptions" (e.g., money measuring unit, fund concept, going concern) of accounting.

The second is a much more tightly and consistently argued chapter. The history of accounting is divided into four major periods: "development" (pre-1494), "pre-explanatory" (1495–1800), "explanatory" (1800–1950), and "modern" (post-1950). Despite relying heavily on the work of Littleton, the description is well presented. In addition, some examples of developments in India are discussed. But it is surprising to read the author's claim that "the logic of personifying accounts" developed in India in the 1960s as "a new idea" (p. 61).

The next five chapters are directed to discussion of capital, income assets, and liabilities. As indicated above, they are conventional in that instead of a self-consistent theory, the book merely presents the notions that have appeared in the literature. Judged on that level, the book is quite satisfactory. Some of the material is what could be expected to be found in most intermediate texts; for example, the detailing of the various techniques for inventory "valuation" and depreciation. There is an interesting, short discussion of intangibles and some of the problems associated with reporting them.

The eighth chapter is entitled *Final Accounts*, presumably with some relevance to curricula in the author's own country. The next chapter examines the major suggested methods for accounting for price-level changes. The orthodox arguments are presented and, to reiterate, with no attachment to a particular theory, the book advocates no one method as superior to others. The author's reliance on secondary sources is apparent in his lack of understanding of continuously contemporary accounting. For example, he argues that "measurement of changes in net assets created over a period is meaningless" as they are not expressed in the same unit (p. 233). One of the strong points of continuously contemporary accounting is that measures of all items *are* expressed in the same units.

The book is written in English. No book is completely error-free, but there are far too many errors in this book to make it useful to an international audience. Many of these errors may well be editorial, but there are numerous examples of awkward and incorrect expression as well as other errors such as incorrect citations.

It is unfortunate to have to be so negative about something which has consumed a considerable amount of the author's intellectual and physical energies. There are many teachers who prefer the "catalog" approach to accounting theory and to them this book may be very useful. It does provide insights into accounting in an area (India) about which most readers of this journal probably know little. There are also some very positive pedagogic features in the book. First, there are the examples the author has devised to illustrate the arguments under discussion. Second, in many cases the discussion is followed by a summary of the argument and some critical comment. Questions relating to the material covered in each of the chapters are included at the end of the book. Some of these are very general, some quite searching.

For reasons given above it is not possible to recommend this book unequivocally. Nevertheless, there are some positive features which make this a useful text to which reference could be made.

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NEW BOOKS: AN ANNOTATED LISTING

Editor's Note: As a general policy, books received but not reviewed in this or future issues will be annotated. There will be some exceptions.

MUMTAZ AHMED and DAVID ALDERMAN, *Project Management: A Management Accounting Perspective* (Hamilton, Ontario: The Society of Management Accountants of Canada, 1986, pp. xv, 254, Can. $11.25 paper–members, Can. $15.00 paper–nonmembers).

Study examines the role of the management accountant as project controller and key support person to line management. Focus is on the execution phase of a project and on the six elements that constitute a control system: planning, budgeting, measuring, analyzing, reporting, and controlling. The authors see a need for source material on the design and operation of a project control system. Hence, the emphasis of the monograph's nine chapters is on presenting the tools of management accounting as they relate to the project environment. The core of the study considers the six control elements while addressing concerns directly relevant to the project controller. An illustration of an industrial expansion project at the end of each chapter reinforces issues raised in the chapter and serves as an application of concepts to a real-life situation Mumtaz Ahmed is a Principal, and David Alterman is a Partner and Director of Operations in the Toronto management consulting practice of Touche Ross.

JERRY L. ARNOLD and MICHAEL A. DIAMOND, *EDGAR: The SEC's Pilot Program and Its Impact* (Morristown, NJ: Financial Executives Research Foundation, 1986, pp. iv, 22, $8.00 paper).

EDGAR is the Electronic Data Gathering, Analysis, and Retrieval System and was adopted by the SEC in 1984. It concerns the formal transition of the Commission from paper filing to electronic data transmission. This study describes EDGAR; relates the experiences of the companies which participated in the SEC's pilot program; and, based on information gathered from these pilot companies, makes recommendations for bringing EDGAR into the organization. The authors see the study as especially pertinent because (1) the SEC is currently developing the operational system and establishing rules for EDGAR, and (2) the SEC will eventually require all firms and individuals to use EDGAR to file electronically. Potential users of EDGAR are encouraged to "participate actively in the dialogue during the rule-making process." Jerry L. Arnold and Michael A. Diamond are Professors at the University of Southern California.

BHABATOSH BANERJEE, *Financial Policy and Management Accounting*, 2nd Edition (Calcutta: The World Press Private, Ltd., 1987, pp. xv, 844).

Textbook draws together the disciplines of Financial Management and Management Accounting. Fourteen chapters cover topics such as Working Capital Management, Cost of Capital, Management Control Systems, and Cost Information and Management. Each chapter includes commentaries on current practices and applications (particularly in India), exercises with answers, and suggested readings. Bhabatosh Banerjee is Professor, Department of Commerce, Calcutta University.

JONATHAN BATSON, "Spreadsheet Good Practice," *Accountants Digest No. 200* (London: The Institute of Chartered Accountants in England and Wales, 1987, pp. 36, £5.50 paper).

Digest presents guidelines on the use of spreadsheets to ensure accurate calculations. By following standards of "Good Practice," the user can control logical consistency of spreadsheets; prevent spreadsheets from becoming unwieldy and unmaintainable; build in error-diagnosing control checks; and test and document spreadsheets. Eight short chapters describe these "Good Practice" standards through consideration of specification, design, coding, testing, documentation, implementation, and management of spreadsheets. Digest is written not only for designers of spreadsheets but for their managers who are responsible for the accuracy of spreadsheet data. A "Handy Hint" section appears throughout as a checklist for the user. Jonathan Batson is in the Decision Systems Group of Deloitte Haskins and Sells, Management Consulting Division.

R. J. CHAMBERS and F. L. CLARK, *Varieties and Uses of Financial Information, Monograph No. 6* (Sydney: University of Sydney Accounting Research Centre, 1986, pp. 75).

Monograph consists of two papers which present the results of surveys on the theme of the "utility of accounting information derived by traditional and alternative processes." The first paper, "Varieties and Uses of Financial Information," reports the findings of a survey of accountants in Australia in 1984. The objective of the study was to examine the "pertinence to financial judgment and actions" of some common practices and ideas. The second paper, "The Functional Utility of Resale Price Accounting," examines the results of surveys conducted on the same topic in Australia, Canada, New Zealand, South Africa, and the United States from 1980 to 1984. An edited version of the study appears in the Fall 1986 issue of *The International Journal of Accounting Education and Research*. The authors conclude that the results question the "functional fitness" of some traditional and alternative practices and "suggest the superiority of periodical accounting on an exit price or resale price basis." R. J. Chambers is Professor Emeritus and F. L. Clark was Associate Professor, when the article was written, at the University of Sydney.

DONALD H. CHEW, JR., Editor, *Six Roundtable Discussions of Corporate Finance with Joel Stern* (New York; Westport, CT; and London: Quorum Books, 1986, pp. xvi, 329, $39.95).

Report of discussions among financial theorists and practitioners on six topics which include Financial Communication, Dividend Policy, Mergers and Acquisitions, Corporate Restructuring, Capital Structure, and Management Compensation. A position paper precedes each discussion. The objective of the book is to build a bridge between modern finance theory and corporate practice. Donald Chew is a Founding Partner of and Director of Publications for Stern Stewart and Company.

CLIVE R. GRUMBALL, *Managing Interest Rate Risk* (New York; Westport, CT: Quorum Books, 1987, pp. x, 150, $39.95).

Five chapters discuss the products of hedging risk: financial futures, forward rate agreements, swaps, interest rate options and guarantees, and other arbitrage situations. Basic implications for taxation and accounting for these risk management techniques also are considered. An appendix lists contract specifications of U.K. and U.S. financial futures and options. Clive R. Grumball is Managing Director of County NatWest Capital Markets Limited.

G. TIMOTHY HAIGHT, *The New Limited Partnership Investment Advisor: A Guide to Superior Returns Through Today's Limited Partnerships* (Chicago: Probus Publishing Company, 1987, pp. 258, $27.50).

Thirteen chapters assist the reader in evaluating limited partnerships as investments. Section one introduces limited partnerships, describes their revenue and expense characteristics, presents financial techniques by which to evaluate limited partnerships, and discusses screening of limited partnerships by reading prospectuses. Section two examines types of limited partnerships, including real estate, mortgage, equipment leasing, oil and gas, research and development, as well as "exotic" limited partnerships such as horse syndication and motion pictures. G. Timothy Haight is Mittendorf Professor of Finance at the University of Baltimore.

KEN HARMON, THOMAS HOWARD, and JAMES PARKER, Editors, *DR Scott Memorial Lectures in Accountancy, Volume XV* (Columbia, MO: The Curators of the University of Missouri, 1986, pp. 95, $10.00 paper).

Represents one in a series of lectures presented in honor of DR Scott, Professor of Accounting and Statistics at the University of Missouri-Columbia for 40 years. Three lectures included in this volume discuss tax reform, the development of knowledge-based accounting systems, and research in accounting education. Three student papers cover environmental influences on accounting before 1900, tax exemption for deaf taxpayers, and governmental accounting for projects and services funded by special assessments. Ken Harmon is Assistant Professor, Thomas Howard is Associate Professor, and James Parker is Professor at the School of Accountancy, University of Missouri-Columbia.

IRWIN M. JARETT, *Financial Reporting Using Computer Graphics* (New York; Chichester, England; Brisbane; Toronto; and Singapore: John Wiley & Sons, 1987, pp. xx, 383, $29.95 paper).

Guide to the application of computer graphics technology as a means to present data for decision making. The first four chapters of the book define and detail the design of a graphics management information system. Chapters 5 through 15 describe "subsystems" designed for graphic presentation of, for example, financial statement and inventory data. Chapter 16 indexes key indicators and ratios, while the final chapter discusses "basic media concerns." Examples and sample graphs are provided. Irwin M. Jarett is Director of Management Information Services for the Chicago office of Pannell Kerr Forster.

SIMON M. KEANE, *Efficient Markets and Financial Reporting* (Edinburgh: The Institute of Chartered Accountants of Scotland, 1987, pp. 55, £5.00 paper).

Monograph discusses the Efficient Market Hypothesis (EMH). The emphasis is on its implications for investment strategy and financial reporting. First part of the monograph defines the EMH and presents evidence for and against market efficiency. It concludes that the market exhibits "semi-strong" efficiency with share prices responding immediately and in an unbiased way to new information. Second part discusses implications for investors and questions the value of investment advisors to the average investor. Third section considers the implications of the EMH for financial reporting and suggests the use of a market-reporting process which is separate from the standard income reporting process. Simon M. Keane is Professor in the Department of Accounting and Finance at the University of Glasgow.

JOHN Y. LEE, *Managerial Accounting Changes for the 1990s* (Artesia, CA: McKay Business Systems, 1987, pp. iv, 87, $6.95 paper).

Seven chapters evaluate changes in the influence of foreign competition; responsive behavior of management; Japanese management practices and production methods; and advances in manufacturing technology on cost and managerial accounting. Discussion is structured into three parts: (1) developments which affect product costing systems and controls; (2) developments which influence performance measurement and other aspects of management control systems; and (3) developments which can be classified as special topics. John Y. Lee is Professor of Accounting and Acting Graduate Dean, School of Business and Economics, California State University at Los Angeles.

SHERMAN L. LEWIS, *Evaluating Corporate Investment and Financing Opportunities* (New York; Westport, CT; and London: Quorum Books, 1986, pp. xiv, 295, $49.95).

Written for practitioners of corporate finance, consultants, and academics, the book views financial management as a tripartite activity encompassing the processes of planning, investing, and financing. Part one, on the planning process, includes a discussion of financial management, financial statement analysis, and financial planning. The second part, on investing, deals with capital expenditures, net current assets, uncertainty and risk, bond refunding and defeasance, and acquiring other companies. Part three, on financing, covers securities valuation, financial leases, claims on common stock, capital structure, and foreign currencies. Each topic is presented within the framework of the three processes to underscore the interrrelationships of profitability, liquidity, and risk. An appendix includes present value tables and illustrations of their use.

ALEXANDER MALCOLM, *A Treatise of Book-Keeping, or, Merchant Accounts*, Accounting Thought and Practice Through the Years series (New York and London: Garland Publishing, Inc. [1731], 1986, pp. 264, $40.00).

The author's preface to this 18th century treatise states that it is a "System or Course of Lessons." Three chapters cover the Principles and Rules of Book-keeping. These principles are termed "not very difficult" by the author, who nevertheless cautions that "much depends upon a right Explication." Following the chapters are two sets of Books of Accounts (each including Waste-Book, Journal, and Ledger) and an Appendix concerned with application of principles. At the time of original publication, Alexander Malcolm was "Teacher of the Mathematicks at Aberdeen."

ROBERT W. MCGEE, *A Model Program for Schools of Professional Accountancy* (Lanham, MD; New York; and London: University Press of America, 1987, pp. xiii, 192, $13.75 paper).

Two-part book advocates innovation in the teaching of accounting, stating that accounting education should be controlled by the accounting profession, not the American Assembly of Collegiate Schools of Business. Part one examines the current status of accounting education, describing the requirements of specific degree programs; presents arguments for and against schools of professional accountancy; and considers standards and practices of other professional schools (law and medical school programs, among others). Part two offers a model for schools of professional accountancy, specifying faculty characteristics and programs and methods of study. An appendix summarizes programs at non-traditional colleges in the U.S. and lists British universities that have diverse residence/coursework requirements and lower fees than their American counterparts. Robert W. McGee is Professor of Accounting and Taxation at the W. Paul Stillman School of Business, Seton Hall University.

JEROME B. MCKINNEY, *Effective Financial Management in Public and Nonprofit Agencies* (New York; Westport, CT; and London: Quorum Books, 1986, pp. xiv, 378, $49.95).

Book is intended to provide an integrated approach to financial management in the public and not-for-profit sector, linking together the fiscal side (budgeting, financing, and controlling) and the substantative management side (planning, programming, and evaluating). The 20 chapters discuss such issues as cash management, expenditure forecasting, risk management, and fiscal health and fraud, in a manner which combines theory and practice. Jerome B. McKinney is Associate Professor at the Graduate School of Public and International Affairs, the University of Pittsburgh.

JOSEPH M. MORRIS, *Joint Ventures: An Accounting, Tax, and Administrative Guide* (New York; Chichester, England; Brisbane; Toronto; and Singapore: John Wiley & Sons, 1987, pp. xii, 324, $47.50).

Twelve chapters consider those aspects of joint ventures, both general and technical, that are relevant to the financial professional. Among topics discussed are accounting for investments and for research and development joint ventures, federal tax aspects of joint venture formation and operation, and SEC requirements. Three appendices provide examples of a Corporate Joint Venture Agreement, a Joint Venture Partnership Agreement, and a Personnel Services Agreement. Joseph M. Morris is Vice President-Corporate Controller at Scientific Software-Intercomp, Inc. Charles A. Hawes is President of Stautzenberger College.

GRAHAM MOTT, *Management Accounting* (Hants, England and Brookfield, VT: Gower Publishing Company, 1987, pp. 231, $35.50).

Book written to familiarize managers with costing and management accounting techniques. Part one reviews costing and pricing; part two considers planning and control; and part three examines the use of costing information for decision making. Graham Mott is Principal Lecturer in Financial Management at Newcastle Polytechnic.

K. MICHAEL OLDHAM, *Accounting Systems and Practice in Europe*, 3rd Edition (Hants, England and Brookfield, VT: Gower Publishing Company, 1986, pp. xiii, 333, $68.95).

First four chapters assess the current state of European accounting systems and practice, its problems and future. The remaining chapters give national surveys of Belgium, Denmark, France, Germany, Greece, Italy, Luxembourg, The Netherlands, Portugal, Spain, The United Kingdom, and the Republic of Ireland (current members of the European Economic Community) as well as Sweden and Switzerland. This material incorporates recent legislation in nine of these countries as well as accounting legislation by the EEC through mid-1985. Six appendices cover accounting prescriptions in the Fourth, Seventh, and Eighth Directives and other matters. K. Michael Oldham is Associate Dean of the School of Business and Social Sciences at The Hatfield Polytechnic.

EARL A. SALIERS, Editor, *Accountant's Handbook, Volumes I and II*, Accounting Thought and Practice Through the

Years series (New York and London: Garland Publishing, Inc. [1923], 1986, pp. 1596, $240.00).

Published in 1923, the first handbook in accounting was intended to serve as a comprehensive reference for the accountant, incorporating information on related fields. Thirty-two sections, which are indexed in detail, facilitate use. The final section is a glossary of terms. The book summarizes information from the disciplines of accounting, finance, and law; reviews fundamentals of mathematics and statistics; and describes a variety of practical, business-related matters (e.g., office practice and appliances). Earl A. Saliers was, at the time of original publication, Associate Professor of Accounting at Northwestern University.

ROBERT F. SLIMMON, *Successful Pension Design for Small-to-Medium-Sized Businesses* (Englewood Cliffs, NJ: Prentice-Hall, Inc., 1987, pp. xix, 440, $39.95).

Fourteen chapters intended to assist the practitioner in designing a pension plan for the small business. Book is written to show how to evaluate client objectives, choose an appropriate plan, and manage the efficient implementation of the plan. Appendices discuss actuarial methodology and provide an actual pension plan document. Volume is updated for the Tax Reform Act of 1986, but does not deal with transitional rules.

MILTON F. USRY, Editor, *Mary Ball Washington Forum Series in Accounting Education*, Volume III (Pensacola, FL: The University of West Florida, 1987, pp. 89, no charge–paper).

Volume contains papers presented at the University of West Florida between November 1985 and November 1986: "Challenges for the Accounting Profession," by Harold Langenderfer of the University of North Carolina at Chapel Hill; "Excellence in a Professional Career," by Doyle Z. Williams of the University of Southern California; "Professional Certification of Accountants," by Charles T. Zlatkovich of the University of Texas at Austin; "Establishing GAAP for Governments," by Robert J. Freeman of Texas Tech University; and "Cost Accounting in a Robotic Environment," by Robert B. Sweeney of Memphis State University. Milton F. Usry is Mary Ball Washington Professor of Accountancy at The University of West Florida.

JOSEPH W. WILKINSON and DAN C. KNEER, *Information Systems for Accounting and Management: Concepts, Applications, and Technology* (Englewood Cliffs, NJ: Prentice-Hall, Inc., 1987, pp. x, 338, $26.67).

Text is a collection of 23 articles organized into eight topics which are introduced by the authors. Topic one covers the planning of management information systems. Topics two and three consider the MIS development life cycle, from systems analysis to implementation and evaluation, and related economic, organizational, and management concerns. Topics four, five, and six discuss technological developments. Topics seven and eight examine current developments in computer auditing, the impact of microcomputers, and emerging technologies such as office automation. Questions formulated by the authors follow each article. Joseph W. Wilkinson is Professor and Dan C. Kneer is Associate Professor at Arizona State University.

Editor's Note: Catherine McNally assisted the Editor in annotating these books.

Books Received from February 10, 1987 to May 15, 1987

Mumtaz Ahmed and David Alderman, *Project Management: A Management Perspective* (Hamilton, Ontario: The Society of Management Accountants of Canada, 1986, pp. xv, 254, Can. $11.25 paper-members, Can. $15.00 paper-nonmembers).

Jerry L. Arnold and Michael A. Diamond, *EDGAR: The SEC's Pilot Program and Its Impact* (Morristown, NJ: Financial Executives Research Foundation, 1986, pp. iv, 22, $8.00 paper).

Bhabatosh Banerjee, *Financial Policy and Management Accounting*, 2nd Edition (Calcutta: The World Press Private, Ltd., 1987, pp. xv, 844).

Jay B. Barney and William G. Ouchi, Editors, *Organizational Economics* (San Francisco and London: Jossey-Bass Publishers, 1986, pp. xix, 495, $32.95).

K. D. Bartlett and Clark Whitehill, "Aspects of Social Security Benefits 1986/7," *Accountants Digest No. 197* (London: The Institute of Chartered Accountants in England and Wales, 1986, pp. 48, £5.50 paper).

Jonathan Batson, "Spreadsheet Good Practice," *Accountants Digest No. 200* (London: The Institute of Chartered Accountants in England and Wales, 1987, pp. 36, £5.50 paper).

Germain Böer, *Classifying and Coding for Accounting Operations* (Montvale, NJ: National Association of Accountants, 1987, pp. vii, 77, $11.95 paper).

Germain Böer, *Decision Support Systems for Management Accountants* (Montvale, NJ: National Association of Accountants, 1987, pp. viii, 49, $7.95 paper).

Michael Bromwich and Anthony G. Hopwood, Editors, *Research and Current Issues in Management Accounting* (London: Pittman Publishing Limited, 1986, pp. 236, £19.95).

Stewart L. Brown and Steven Errera, *Trading Energy Futures* (New York; Westport, CT; and London: Quorum Books, 1987, pp. xiv, 202, $37.95).

David Cohen and John Power, "Tax Aspects of Going Public," *Tax Digest No. 50* (London: The Institute of Chartered Accountants in England and Wales, 1986, pp. 36, £5.50 paper).

R. J. Chambers and F. L. Clark, *Varieties and Uses of Financial Information, Monograph No. 6* (Sydney: University of Sydney Accounting Research Centre, 1986, pp. 75).

Donald H. Chew, Jr., Editor, *Six Roundtable Discussions of Corporate Finance with Joel Stern* (New York; Westport, CT; and London: Quorum Books, 1986, pp. xvi, 329, $39.95).

Ian Collins and Patrick Forsyth, "Client Development," *Accountants Digest No. 196* (London: The Institute of Chartered Accountants in England and Wales, 1986, pp. 52, £6.00 paper).

J. R. Edwards, Editor, *Legal Regulation of British Company Accounts: 1836-1900*, Accounting Thought and Practice Through the Years series (New York and London: Garland Publishing, Inc., 1986, Volume I, pp. 335; Volume II, pp. 368, $80.00).

Kenneth R. Ferris and J. Leslie Livingstone, Editors, *Management Planning and Control*, Revised Edition (Columbus, Ohio: Century VII Publishing Co., 1987, xvii, 249, $15.95 paper).

Walter Georges and Robert W. McGee, *Analytical Contribution Accounting* (New York; Westport, CT; and London: Quorum Books, 1987, pp. xii, 254, $39.95).

Howard H. Greenbaum, Editor, *Management Auditing as a Regulatory Tool: The New York State Experience* (New York; Westport, CT; London: Praeger, 1987, pp. xx, 347, $49.95).

Ellen S. Goldberg and Dan Haendel, *On Edge: International Banking and Country Risk* (New York; Westport, CT; London: Praeger, 1987, pp. 116, $32.95).

Paul A. Griffin and Richard P. Castanias II, *Accounting for the Translation of Foreign Currencies: The Effects of Statement 52 on Equity Analysts*, Research Report (Stamford, CT: Financial Accounting Standards Board, 1987, pp. viii, 112, $16.00 paper-students, $20.00 paper-other).

Clive R. Grumball, *Managing Interest Rate Risk* (New York; Westport, CT: Quorum Books, 1987, pp. x, 150, $39.95).

G. Timothy Haight, *The New Limited Partnership Investment Advisor: A Guide to Superior Returns Through Today's Limited Partnerships* (Chicago: Probus Publishing Company, 1987, pp. 258, $27.50).

J. Philip Hardman, "The Tax Implications of Management Buy-outs," *Tax Digest No. 53* (London: The Institute of Chartered Accountants in England and Wales, 1987, pp. 24, £5.00 paper).

R. Hill and J. P. Howarth, "Tax Aspects of Incorporation," *Tax Digest No. 54* (London:

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GABRIEL HAWAWINI and PIERRE A. MICHEL, *Mandatory Financial Information and Capital Market Equilibrium in Belgium*, Accounting Thought and Practice Through the Years series (New York and London: Garland Publishing, Inc., 1987, pp. 271, $25.00).

DAVID F. HAWKINS, *Corporate Financial Disclosure, 1900–1933*, Accounting Thought and Practice Through the Years series (New York and London: Garland Publishing, Inc., 1986, pp. xii, 529, $55.00).

ROBIN M. HOGARTH and MELVIN W. REDER, Editors, *Rational Choice: The Contrast Between Economics and Psychology* (Chicago and London: The University of Chicago Press, pp. ix, 332, $15.00 paper, $30.00).

Indian Journal of Accounting, Vol. XV, Part I, (Calcutta: Indian Accounting Association, 1985, pp. 52).

IRWIN M. JARETT, *Financial Reporting Using Computer Graphics* (New York; Chichester, England; Brisbane; Toronto; and Singapore: John Wiley & Sons, 1987, pp. xx, 383, $29.95).

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SIMON M. KEANE, *Efficient Markets and Financial Reporting* (Edinburgh: The Institute of Chartered Accountants of Scotland, 1987, pp. 55, £5.00 paper).

JOHN H. KELLAS, *Investigations and Reports: A Handbook* (London: The Institute of Chartered Accountants in England and Wales, 1987, pp. 170, £11.95 paper).

P. D. KIRK and J. M. ANDREWS, "Guide to the Taxation of Foreign Nationals Working in the United Kingdom," *Tax Digest No. 49* (London: The Institute of Chartered Accountants in England and Wales, 1986, pp. 40, £5.50 paper).

J. S. H. KORNBLUTH and G. R. SALKIN, *The Management of Corporate Financial Assets: Applications of Mathematical Programming Models* (London; Orlando; San Diego; New York; Austin; Boston; Sydney; Tokyo; Toronto: Academic Press, Harcourt Brace Jovanovich, Publishers, 1987, pp. xi, 348, $40.00).

JOHN Y. LEE, *Managerial Accounting Changes for the 1990s* (Artesia, CA: McKay Business Systems, 1987, pp. iv, 87, $6.95 paper).

SHERMAN L. LEWIS, *Evaluating Corporate Investment and Financing Opportunities* (New York; Westport, CT; and London: Quorum Books, 1986, pp. xiv, 295, $49.95).

ALEXANDER MALCOLM, *A Treatise of Book-Keeping, or, Merchant Accounts*, Accounting Thought and Practice Through the Years series (New York and London: Garland Publishing, Inc., [1731] 1986, pp. 264, $40.00).

ROBERT W. MCGEE, *A Model Program for Schools of Professional Accountancy* (Lanham, MD; New York and London: University Press of America, 1987, pp. xiii, 192, $13.75 paper).

JEROME B. MCKINNEY, *Effective Financial Management in Public and Nonprofit Agencies* (New York; Westport, CT; and London: Quorum Books, 1986, pp. xiv, 378, $49.95).

MARTIN MELLMAN, STEVEN B. LILIEN and JAMES M. DOCHERTY, *Discovery Techniques: Obtaining and Analyzing Business Financial Data* (Boston, MA and New York: Warren, Gorham and Lamont, 1987, paginated by section, $85.00).

JOSEPH M. MORRIS, *Joint Ventures: An Accounting, Tax, and Administrative Guide* (New York; Chichester, England; Brisbane; Toronto and Singapore: John Wiley & Sons, 1987, pp. xii, 324, $47.50).

GRAHAM MOTT, *Management Accounting* (Hants, England and Brookfield, VT: Gower Publishing Company, 1987, pp. 231, $35.50).

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TERRY K. SHELDAHL, *Beta Alpha Psi, from Omega to Zeta Omega: The Making of a Comprehensive Accounting Fraternity, 1946–1984*, Accounting Thought and Practice Through the Years series (New York and London: Garland Publishing, Inc., 1986, pp. xxiii, 851, $75.00).

ROSS M. SKINNER, *Accounting Standards in Evolution* (Toronto: Holt, Rinehart and Winston of Canada, Limited, 1987, pp. xv, 712, Can. $44.95).

ROBERT F. SLIMMON, Successful Pension Design for Small- to Medium-Sized Businesses (Englewood Cliffs, NJ: Prentice-Hall, Inc., 1987, pp. xix, 440, $39.95).

RODNEY D. STEWART and RICHARD M. WYSKIDA, A Wiley-Interscience Publication, *Cost Estimator's Reference Manual* (New York; Chichester, England; Brisbane; Toronto and Singapore: John Wiley & Sons, 1987, pp. xxiii, 620, $59.95).

RON TEPPER, *Become a Top Consultant* (New York; Chichester, England; Brisbane; Toronto and Singapore: John Wiley & Sons, 1987, pp. xx, 243, $12.95 paper).

RON TEPPER, *The Consultant's Problem-Solving Workbook* (New York; Chichester, England; Brisbane; Toronto and Singapore: John Wiley & Sons, 1987, pp. 323, $49.95).

COLIN J. M. THOMPSON, *How to be Successful in Business* (Solihull, England: Marcus Tobias, 1986, pp. 121, £9.95 paper).

JOHN L. WARD, *Keeping the Family Business Healthy* (San Francisco and London: Jossey-Bass, Inc., 1987, pp. xxix, 266, $22.95).

MILTON F. USRY, Editor, *Mary Ball Washington Forum Series in Accounting Education*, Volume III (Pensacola, FL: The University of West Florida, 1987, pp. 89, no charge-paper).

JOSEPH W. WILKINSON and DAN C. KNEER, *Information Systems for Accounting and Management: Concepts, Applications, and Technology* (Englewood Cliffs, NJ: Prentice-Hall, 1987, pp. x, 338, $26.67).

FELLOWSHIP AWARD WINNERS

The American Accounting Association's Student Fellowship Committee met in San Francisco on April 9, 1987 to select the 1987-88 recipients of the American Accounting Association grants. The committee was chaired by James W. Deitrick, The University of Texas at Austin, John M. Hassell, Florida State University, Talmadge C. Tillman, Jr., California State University at Long Beach. The Fellowship Committee was authorized to grant $5,000 awards for 1987-88 to outstanding applicants based only upon academic merits. The committee selections were based upon the applicants' attributes and accomplishments and were made without distinction as to the school at which the applicant would pursue the doctoral studies. The committee reviewed fifty-four applications and granted nine awards of $5,000 each. The Fellowship Award winners were:

Cynthia A. Copp
Michael John Ferguson
Susan Gill
Susan Jane Kennedy
Leslie William Rogers
Cindy Seipel
Sheldon Ray Smith
Thomas Sopkiewicz
Monte R. Swain

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by ROBERT W. INGRAM AND WALTER A. ROBBINS

For-Profit vs Non-Profit Hospitals: The Effect of the Profit Motive on the Management of Operations
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by K. Keasey and R. Watson

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by Neal L. Ushman

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by Sarath P. Abeysekera and Arvind Mahajan

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by A. Wirth and F. K. Wright

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OCTOBER 1987 PLACEMENT ADS

The deadline for information to be included in the "Placement Information" section is two months prior to the date of publication. The Review is published on the first day of January, April, July, and October. Placement advertising and replies should be sent to the American Accounting Association, 5717 Bessie Drive, Sarasota, FL 33583. All replies to box numbers should be on separate sheets to facilitate forwarding. There is no charge for this service to AAA members and associate members seeking employment. Others will be charged a fee of $100 per insertion. Ads should not exceed 100 words.

#401 GEORGE WASHINGTON UNIVERSITY, Department of Accountancy invites applications for tenure-track positions in accounting. Candidates are expected to possess a doctoral degree or be near completion of degree and should be dedicated to teaching excellence and research. GWU is an equal opportunity, affirmative action employer. Please send vita to Dr. Joseph Hilmy, Chairman, Department of Accountancy, George Washington University, 710 21st Street, NW, Room 209, Washington, DC 20052. Telephone (202) 994-6825.

#402 THE UNIVERSITY OF ALABAMA School of Accountancy has openings for accounting faculty, beginning as early as January 1988. Applicants will be considered at all ranks. Visiting positions are possible. Applicants should demonstrate potential for quality teaching and research. Enquiries should be sent to: Robert W. Ingram, Director, School of Accountancy, Drawer AC, University of Alabama, Tuscaloosa, AL 35487.

#403 TULANE UNIVERSITY, The A. B. Freeman School of Business is seeking a research-oriented faculty member in financial accounting or managerial accounting to fill a tenure-track position at the level of assistant professor. Salary and benefits are highly competitive. Please send resumé to Soliman Y. Soliman, Ph.D., Area Coordinator, Accounting and Taxation, A. B. Freeman School of Business, Tulane University, New Orleans, Louisiana 70118-5669. An Equal Opportunity/Affirmative Action Employer.

#404 BOSTON COLLEGE is seeking applications for appointments at the Assistant or Associate levels in Accounting. Applicants for Assistant should possess a Ph.D. or D.B.A. ABD's will be considered. Applicants for Associate must have a proven record in teaching, research, and service. Boston College places a high emphasis on quality teaching. In addition, applicants will be expected to engage in scholarly research and will be supported in their research efforts. The School of Management is AASCB accredited. Boston College is an Equal Opportunity/Affirmative Action Employer. Contact: Dr. Ronald Pawliczek, Department of Accounting, Fulton 400, Boston College, Chestnut Hill, MA 02167.

#405 CLAREMONT McKENNA COLLEGE making a regular tenure-track appointment to the Fletcher Jones Chair in Accounting beginning Fall 1988. Financial Accounting, and in either Auditing, or Tax Law. Demonstrated interest in undergraduate teaching and scholarly research essential. Ph.D. required, professional certification preferred. Senior Associate or Full Professor; salary competitive. CMC is a member of Claremont Colleges. Admission highly selective; program enjoys strong support. Send resumé by 15 November 1987 to Chairman, Accounting Search, Dean of Faculty's Office, Bauer Center, 500 E. 9th Street, Claremont McKenna College, Claremont, California 91711. College is affirmative action, equal opportunity employer.

#406 THE UNIVERSITY OF RICHMOND has two tenure-track positions in accounting for the 1988–89 school year. Rank and salary are open depending on qualifications. Candidates should have a Ph.D. or DBA in Accounting and an interest in the financial or managerial/systems areas. The teaching load is 9 hours with two preparations. Class sizes average 20–30. The University places a balanced emphasis on teaching and research and required qualifications include a demonstrated record or potential in both of these areas. The University of Richmond is located on a beautiful residential campus at the edge of Richmond, Virginia. It has a $200 million endowment —placing it among the top 50 endowments in this country. The University of Richmond is an equal opportunity/affirmative action employer. Applications should include a letter of application, vita, and the names of three references. CONTACT: Francis A. Bird, Chairman, Accounting Department, E. Claiborne Robins School of Business, University of Richmond, VA 23173.

#407 APPLICATIONS FOR POSITIONS IN ACCOUNTING, at all professorial ranks, are invited from qualified persons having research and teaching interests in the areas of auditing, financial, health care, information systems, managerial, and public policy. A Ph.D. is required. Demonstrated ability or potential for effective teaching and quality research are important considerations. The University of Pennsylvania is an equal opportunity/affirmative action employer. Interested persons should send their resumé including educational background, professional experience, publications, personal data, and, if applicable, a dissertation proposal and abstract to: Professor Robert E. Verrecchia, Accounting Department, University of Pennsylvania, Suite 2400 Steinberg Hall-Dietrich Hall, Philadelphia, PA 19104-6365.

#408 SUFFOLK UNIVERSITY, Boston, Massachusetts. The Accounting Department of the School of Management is seeking faculty members to fill tenure-track positions. Teaching will be at the undergraduate/graduate level(s). Primary openings in governmental fund accounting, managerial or financial areas. Qualified candidates should be able to teach in a second accounting area. Evidence of effective teaching, research competence and a strong record of publications required. PhD/DBA in Accounting required. CPA, CMA, or other certification(s) desirable. Apply to Ronald Sundberg, Associate Dean, School of Management, Suffolk University, Beacon Hill, Boston, MA 02108 or call (617) 723-4700, ext. 307. An equal opportunity, affirmative action employer.

#409 THE UNIVERSITY OF UTAH is seeking applications for the position of Assistant/Associate Professor of Accounting. Applicants should hold doctorate or be in final dissertation stages. In addition to teaching responsibilities, all applicants are expected to perform scholarly research. Applicants with interest in financial accounting and/or accounting information systems are urged to apply. Salaries are competitive and fringe benefits are excellent. Bachelor's, M.B.A., M.Pr.A., and Ph.D. programs are offered. Application deadline is December 15, 1987, or until position is filled. Send resumé to Dr. Reed H. Randall, School of Accounting, Graduate School of Business, University of Utah, Salt Lake City, Utah 84112. An equal opportunity/affirmative action employer.

#410 THE UNIVERSITY OF MICHIGAN-FLINT has openings for tenure-track faculty positions at all ranks starting in either September or January. Most interest areas can be accommodated, although preference will be given to candidates in auditing and accounting information systems. Professional certification is desirable. Responsibilities include quality teaching, research, and service. Candidates must have a doctorate or be in the last stages of ABD. Salary is competitive and fringe benefits are excellent. Candidates should send a resumé to Dr. Walter J. Woerheide, School of Management, University of Michigan-Flint, Flint MI 48502-2186. Applications accepted until position is filled. The University of Michigan-Flint is an equal opportunity/affirmative action employer.

#411 THE UNIVERSITY OF SASKATCHEWAN (Canada) is seeking applicants for tenurable and limited term (visiting) positions in Accounting. Rank and salary commensurate with experience and credentials. Strong interests in teaching and research required for both enriched undergraduate program, as well as MBA and M.Sc. Accounting programs. Current department establishment of fourteen hold doctorates from Michigan, Washington, Minnesota, Missouri and Michigan State. Saskatoon, is a beautiful, pollution-free, Western Canadian university city of 180,000 with excellent schools and cultural facilities. Further information can be obtained from: Department Head, Department of Accounting, University of Saskatchewan, Saskatoon, Saskatchewan, Canada S7N 0W0.

#412 NORTHERN ILLINOIS UNIVERSITY is looking for faculty starting August, 1988. All ranks and fields will be considered, but likely openings will be at the assistant level in systems and taxation. Terminal degree required, but ABD's will be considered at the assistant level. CPA or other certification desirable. NIU faculty are committed to excellent teaching, professional involvement, and professional research. Interested applicants should send resumé to John Smith, Chair, Department of Accountancy, Northern Illinois University, DeKalb, IL 60115. Northern Illinois University is an Equal Opportunity, Affirmative Action Employer.

#413 THE COLLEGE OF WILLIAM AND MARY invites applications for a tenure-track position as Assistant Professor of Accounting, effective September, 1988. Candidates must have or be completing a Ph.D. or D.B.A. degree. All faculty members are expected to be involved in both teaching and research. The College of William and Mary is a state-supported, small-scale university with average SAT scores of over 1200. The accounting program is accredited by AACSB. Send resumé to James E. Smith, Director of the Accounting Program, School of Business Administration, College of William and Mary, Williamsburg, VA 23185. AA/EOE. Minorities and women are encouraged to apply.

#414 SAN JOSE STATE UNIVERSITY invites applications for tenure-track and temporary appointments in accounting. The areas of greatest need are accounting information systems, taxation, EDP auditing and cost management systems. In evaluating applications, strong preference will be given to candidates who: demonstrate a record of teaching excellence; possess an appropriate doctorate from an AACSB accredited university (applicants for temporary appointments must possess an MBA or its equivalent); have a record of, and continuing interest in, research and publications; possess professional certification; have shown an ability to work as part of a team; and have excellent communication and interpersonal skills. Salary and rank dependent upon qualifications. Application review will continue until suitable candidates are found. Please contact Tom Black, Chair, Accounting Search Committee, Department of Accounting & Finance, School of Business, San Jose State University, San Jose, CA 95192. Telephone (408) 277-3497. SJSU is an Equal Opportunity/Affirmative Action Employer.

#415 SOUTHERN ILLINOIS UNIVERSITY AT CARBONDALE. Applications are invited for a junior and a senior faculty position in accounting at the assistant, associate, or full professor level beginning on September 1, 1988. A Ph.D. or DBA degree is required (ABD will be considered for the assistant professor level). The candidate considered for the senior position must have an established record of outstanding research. The College of Business and Administration is accredited by the AACSB and the Department of Accountancy has over 600 undergraduate and 40 graduate accounting majors. In addition, the College offers an MBA degree, a M.Acc. Degree, and a DBA degree with an Accounting concentration. Salary will be competitive with current market rates dependent upon the candidate's qualifications and experience. Send resumé to Dr. Frederick H. Wu, Chair, Department of Accountancy, Southern Illinois University, Carbondale, Illinois 62901. SIU-C is an affirmative action employer. Deadline for application is December 31, 1987.

#416 THE UNIVERSITY OF RHODE ISLAND. Visiting Professor position available for senior faculty member (Associate or Full) for Spring 1988 semester or Fall 1988 academic year. Candidates should have a strong record of quality research and teaching. Visiting faculty are expected to collaborate with our faculty members on research and development or graduate seminars. The College of Business Administration is accredited by the AACSB. Salary and benefits are competitive. PhD/DBA required. CPA/CMA preferred. Applicants should submit a letter of application indicating position preference (Spring 1988 or Fall 1988) and a resumé to: Henry Schwarzbach, Chair, Associate/Full Visiting Professor Position, THE UNIVERSITY OF RHODE ISLAND, P.O. Box G, Kingston, RI 02881. An Affirmative Action/Equal Opportunity Employer. Applications will be accepted until position is filled.

#417 OHIO UNIVERSITY has full-time positions for Assistant or Associate Professors to teach financial accounting and/or auditing at the undergraduate level. Ph.D. or D.B.A. in accounting required. Evidence of teaching and research competence is required. Professional certification and experience is desirable. Send resumé to: Professor Donald V. Stuchell, Chairman, Department of Accounting, Ohio University, Athens, Ohio 45701. Ohio University is an Equal Opportunity/Affirmative Action Employer.

#418 DIRECTOR OF THE SCHOOL OF ACCOUNTANCY, College of Business, Arizona State University. Nominations and applications are invited for the position of Director of the School of Accountancy. Candidates should have a record of research, teaching, and service commensurate with full professor rank at a major university. Prior experience in faculty governance is desirable. Position requires effective leadership in interacting with faculty, students, administrators, and members of the business and professional community. Applications and nominations will be accepted until October 31, 1987 or until such time as a qualified applicant is selected. Please send vita to Professor James Boatsman, School of Accountancy, College of Business, Arizona State University, Tempe, AZ 85287. Arizona State University is an Equal Opportunity/Affirmative Action Employer.

#419 INDIANA STATE UNIVERSITY is seeking faculty members in Accounting for tenure-track positions beginning August 1988. Teaching interests may be in the Financial, Auditing, or Income Tax/Business Law areas. Earned doctorate with CPA or CMA certification is preferred; ABDs will be considered. A JD with masters (Law or Accounting) with CPA will be considered for tax/business law area. All interested parties are encouraged to apply. Send resumé to Dr. Henry Longfield, Chairman, Department of Accounting, Indiana State University, Terre Haute, Indiana 47809. Indiana State University is an equal opportunity/affirmative action employer.

#420 THE UNIVERSITY OF CALIFORNIA AT LOS ANGELES. Applications are invited for positions in accounting at both the junior and senior levels for appointments beginning on July 1, 1988. Applicants must have a Ph.D. degree or be a Ph.D. candidate and must exhibit outstanding research capability. Resumés should be sent to Professor Wayne Landsman, John E. Anderson Graduate School of Management, University of California, Los Angeles, CA 90024-1481. Telephone: 213-825-3930. UCLA is an Affirmative Action, Equal Opportunity Employer.

#421 WRIGHT STATE UNIVERSITY has tenure-track faculty openings for 1988–89. Areas of primary interest are auditing, systems and financial. PhD or candidate in dissertation stage required. Professional certification desired. Rank dependent upon credentials. MBA/CPA with teaching and practical experience will be considered for non-tenured appointment as instructor. Competitive salary with excellent fringe benefits. Programs AACSB accredited. Send letter of application and resumé with references to J. B. Paperman, Department of Accountancy, Wright State University, Dayton, OH 45435.

#422 JAMES MADISON UNIVERSITY School of Accounting has two positions available for the fall 1988 semester. One position is in systems and the other in taxation. Candidates should hold a doctorate (or have a Masters in taxation with a law degree) or be ABD with demonstrated progress toward completion. Duties include those normally associated with academic teaching such as research and professional activities. JMU is state-supported and located in the beautiful, historic Shenandoah Valley of Virginia. Programs offered include the B.B.A. (Accounting), M.S.A. and M.B.A. The undergraduate and graduate accounting programs and the undergraduate and graduate business programs are all AACSB-accredited. Submit vita to: Dr. Ashton C. Bishop, School of Accounting, James Madison University, Harrisonburg, Virginia 22807. (703) 568-6844. AA/EOE.

#423 UNIVERSITY OF NEW ORLEANS invites applications for the position of Assistant or Associate Professor of Accounting. Candidates should have the PH.D. or DBA degree. Evidence of excellence in teaching, research, and professional activities is necessary. Salary is negotiable and competitive. The University offers the M.S. in Accounting and the M.S. in Accounting (tax option), as well as the M.B.A. Approximately 700 undergraduate accounting majors are enrolled. The University has AACSB accreditation at both the undergraduate and graduate levels. Candidates should send resumé to Professor Gordon A. Hosch, Chairman, Department of Accounting, College of Business Administration, University of New Orleans, New Orleans, LA 70148. UNO is an Affirmative Action, Equal Opportunity Employer.

#424 LOUISIANA STATE UNIVERSITY, Department of Accounting, anticipates faculty openings for the Fall of 1988. Available openings are at the assistant, associate, and full ranks. Assistant candidates should have a doctorate or be near completion of their doctoral program. Applicants at the upper ranks must have a commensurate research and professional service record. Faculty are generally expected to teach six to nine hours per semester and be actively involved in research and professional service. The University is an Equal Opportunity, Affirmative Action Employer. Please send resumés and references to: Dr. Vincent C. Brenner, Chairman, Department of Accounting, College of Business Administration, Baton Rouge, LA 70803.

#425 UNIVERSITY OF CINCINNATI, College of Business Administration seeks candidate for a tenure-track faculty position in the Department of Accounting. Candidates for Assistant Professor should have doctorate or be in advanced dissertation stage; evidence of research and teaching potential is required. Professional certification and business experience is desirable. Send resumé to: Dr. Donald E. Ricketts, University of Cincinnati, College of Business Administration, Department of Accounting/Business Law, Cincinnati, Ohio 45221-0130. The University of Cincinnati is an Affirmative Action/Equal Opportunity Employer.

#426 CLEMSON UNIVERSITY SCHOOL OF ACCOUNTANCY is seeking applicants for a tenure-track position for August 1988 or possibly January 1988. Interest areas may include financial accounting, auditing, not-for-profit, and information systems. Applicants should have a completed doctorate or nearing completion for Assistnat Professor appointment. Professional certification is desirable. Candidates must have a strong interest in research and possess relevant research skills. Salary and fringe benefits are competitive. Clemson University is an Affirmative Action/Equal Opportunity Employer. Please send vita to Jerry E. Trapnell, Director, School of Accountancy, 301 Sirrine Hall, Clemson University, Clemson, South Carolina 29634-1303.

#427 LEWIS AND CLARK COLLEGE seeks qualified applicants for tenure-track position in accounting commencing September 1, 1988. An appropriate doctorate is required. Will be responsible for managerial and cost accounting courses, and other courses in the undergraduate accounting/business curriculum compatible with background and interests. Teaching excellence, research, and professional activities are expected. Rank and salary are open and commensurate with candidate's qualifications. Lewis and Clark is a private institution with approximately 1,500 students. Send vita to: Dr. Phillip Senatra, Department of Business & Administrative Studies, Lewis & Clark College, Portland, OR 97219. Closing date January 1, 1988. AA/EOE.

#428 FACULTY POSITION—Carnegie Mellon University is searching for tenure-track faculty to teach accounting in graduate and undergraduate programs. Individuals should have training in the disciplines of economics, finance, mathematics and statistics, and in addition should have demonstrated the potential for excellence in research (in the case of entry-level positions) or a proven record of excellence in research (in the case of non-entry-level positions). Applicants should submit a current vitae and evidence of research such as publications, working papers, or dissertation proposal and chapters to: Professor Srikant Datar, Graduate School of Industrial Administration, Carnegie Mellon University, Pittsburgh, PA 15213-3890. Carnegie Mellon University is an equal opportunity/affirmative action employer.

#429 THE UNIVERSITY OF NEBRASKA AT OMAHA invites applicants for Accounting Department Chair. The department offers both MPA and undergraduate programs and consists of 14 FTE faculty. CBA enrollment exceeds 3,600 undergraduates and 300 graduate students. Located in mid-continent, Omaha offers big city opportunities and smaller community conveniences. The salary is competitive and commensurate with qualifications. An earned doctorate and a strong record of scholarly research, teaching, and professional activity required. Applications accepted until position is filled. Contact Professor Virginia L. Bean, Chair of Search Committee, CBA 501, The University of Nebraska at Omaha, Omaha, NE 68182-0047. (402) 554-3658. Equal Opportunity/Affirmative Action Employer.

#430 THE UNIVERSITY OF NEBRASKA AT OMAHA invites applicants for Assistant Professor of Accounting. The department offers both MPA and undergraduate programs and consists of 14 FTE faculty. CBA enrollment exceeds 3,600 undergraduate and 300 graduate students. Located in mid-continent, Omaha offers big city opportunities and smaller community conveniences. The salary is competitive and commensurate with qualifications. An earned doctorate (ABD considered) and potential for and interest in scholarly research, teaching, and professional activity required. Applications will be accepted until position is filled. Contact Professor Virginia L. Bean, Chair of Search Committee, CBA 501, The University of Nebraska at Omaha, Omaha, NE 68182-0047. (402) 554-3658. Equal Opportunity/Affirmative Action Employer.

#431 ACCOUNTING—Two tenure-track positions available January 1, 1988 or August, 1988. Rank and salary open, dependent upon qualifications and publication record. Compensation is competitive with similar AACSB institutions. Earned doctorate with sound record of research and publication required. Teaching load reductions possible for research. Teaching assignments are flexible. Current needs include accounting systems and governmental. Women and minorities are encouraged to apply. Send applications and inquiries to Office of Academic Affairs, Dr. Jack Hall, Head, Accounting Search, Western Kentucky University, Bowling Green, KY 42101. An affirmative action, equal opportunity employer.

#432 ACCOUNTING: tenure-track or visiting position(s) anticipated starting Fall, 1988; PhD/DBA (accounting) required; CPA or CMA desirable; assistant professor rank preferred; ABD (advanced stages) considered for initial non-tenure appointment. Send resumé to Dr. David Fetyko, Department of Accounting, 434 BSA, Kent State University, Kent, OH 44242 (216-672-2545). Deadline: January 15, 1988. KSU is an AA/EO employer.

#433 SAN FRANCISCO STATE UNIVERSITY has tenure-track accounting faculty openings in financial accounting and auditing with knowledge of computers particularly desirable beginning Summer or Fall 1988 in our AACSB accredited undergraduate and master's programs. Salary and rank are open commensurate with academic preparation and professional experience. An appropriate doctoral degree or ABD status, professional experience and/or certification are required. A faculty member is expected to teach accounting undergraduate and graduate courses, to engage in instructional and professional activities, and research; major emphasis is teaching effectiveness. San Francisco State is an Equal Opportunity/Affirmative Action/Handicapped/ Title IX Employer. Send application letter and resumé to Professor James F. Schremp, Chair, Department of Accounting and Finance, School of Business, San Francisco State University, 1600 Holloway Avenue, San Francisco, California 94132. Closing date for applications is February 15, 1988.

#434 UNIVERSITY OF IDAHO. The Department of Accounting invites applications for a tenure-track faculty position at the assistant or associate professor rank. Applicants should have an interest in teaching and research in financial and/or managerial accounting topics. Ph.D. or DBA in accounting is required. Professional certification and experience desirable. ABD's will be considered. Qualified candidates should send a letter of application and resumé to: Jeffrey L. Harkins, Department of Accounting, University of Idaho, Moscow, ID 83843. The UI is an EO/AA employer.

#435 JOHN CARROLL UNIVERSITY is seeking to fill two tenure-track positions, one at the full professor level and one at the associate/assistant. Candidates should have an earned Ph.D. (D.B.A.) in Accounting. Desired specializations include, but are not limited to, Auditing, MIS, and Taxation. We are particularly interested in filling one position with an empirical researcher. Normal load is 4½ courses per year. Ample institutional support for research and travel. Position available January, 1988 or September, 1988. Address applications to Mr. Carl Monastra, Acting Chair, Department of Accounting, John Carroll University, University Heights, Ohio 44118. JCU is an EE/AA employer.

#436 THE OHIO STATE UNIVERSITY has several tenure-track openings for Assistant Professors of Accounting or Management Information Systems, starting September 1988. Ph.D. or D.B.A. is required. CPA, CMA or CIA certificate desirable. Applicant must be committed to excellence in research and teaching. The Ohio State University is an affirmative action and equal opportunity employer. Applications should be directed to Prof. Daniel L. Jensen, Chairman, Recruiting Committee. Faculty of Accounting and Management Information Systems, The Ohio State University, 1775 College Road, Columbus, OH 43210.

#437 THE OHIO STATE UNIVERSITY is looking for visiting professors (any rank) of Accounting or Management Information Systems, starting September 1988. Ph.D. or DBA is required. CPA, CMA or CIA certificate desirable. Applicants must be committed to teaching. The Ohio State University is an affirmative action and equal opportunity employer. Applications should be directed to Prof. F. P. Kollaritsch, Chairman, Faculty of Accounting and Management Information Systems, The Ohio State University, 1775 College Road, Columbus, Ohio 43210.

#438 VIRGINIA COMMONWEALTH UNIVERSITY, RICHMOND, VA., invites applications for three tenure-track positions, rank open, in Accounting. Research and teaching interests in accounting systems or auditing are preferred. Applicants must possess a doctoral degree in accounting or advanced ABD. Professional certification preferred. Undergraduate and graduate accounting programs AACSB accredited. Contact Dr. John B. Sperry, Chairman, Department of Accounting, Virginia Commonwealth University, 1015 Floyd Avenue, Richmond, VA 23284. VCU is an equal opportunity, affirmative action employer. Qualified minorities, women, and members of other protected groups are encouraged to apply.

#439 THE UNIVERSITY OF MASSACHUSETTS at Boston seeks applicants for accounting faculty positions. Candidates should hold Ph.D. or D.B.A. in accounting; candidates nearing completion will also be considered. Rank and salary are dependent on qualifications. CPA, CMA, and CIA would be a plus. The campus has modern facilities and is located at Boston Harbor. The College offers undergraduate and MBA programs, and emphasizes quality instruction and research.

Salary, teaching load and other benefits are very competitive. Apply by 10/15/87 to: Dr. Lal C. Chugh, Chairman, Department of Accounting and Finance, College of Management, University of Massachusetts/Boston, Harbor Campus, Boston, Massachusetts 02125. The University is an equal opportunity/affirmative action (Title IX) employer. Minorities and women are encouraged to apply.

#440 DESIRABLE, PORTLAND, ME. TENURE-TRACK POSITION IN ACCOUNTING. The University of Southern Maine seeks Ph.D. or D.B.A. to teach financial accounting. Teaching and practical accounting experience required; C.P.A. desirable. Teaching effectiveness is emphasized; publications expected. Combine quality of life with professional pursuits. Competitive compensation package. Rank open. Send resumé to, or call: Dr. Philip Jagolinzer, Chairman, Search Committee, Department of Accounting, University of Southern Maine, Portland, ME 04103. USM IS AN EEO/AA EMPLOYER.

#441 THE UNIVERSITY OF MANITOBA is seeking applicants for tenure-track positions in accounting for July 1988. Rank is open, based on qualifications and experience. A visiting appointment is also possible. Ph.D. or DBA, completed or near completion is required. Duties include research and teaching at the undergraduate and graduate levels. Salary is competitive and will depend on qualifications, experience and research record. Winnipeg, a multicultural city of 600,000, offers the best of an urban environment in the heart of Canada's vacation land. Both women and men are encouraged to apply. In accordance with Canadian immigration requirements, priority will be given to qualified Canadian citizens and permanent residents of Canada. Applications should be send to: DR. L. I. GOULD, HEAD, DEPARTMENT OF ACCOUNTING AND FINANCE, UNIVERSITY OF MANITOBA, WINNIPEG, MANITOBA, R3T 2N2.

#442 ASSISTANT/ASSOCIATE/FULL PROFESSOR, STAMFORD, CONNECTICUT CAMPUS. The University of Connecticut has a non-tenure track opening at the Stamford, Connecticut campus starting in the Fall of 1988. Rank is open dependent upon the qualifications of the individual. Salary will be competitive with the national market. Candidates for Assistant Professor should have a doctorate or have completed everything but the dissertation as of the Fall of 1988. Candidates for a senior faculty position must have an established research record in addition to the doctorate. The position offers the opportunity to teach at the undergraduate and graduate level in the fast-growing Stamford area. Contact: Dr. Harold E. Wyman, Department Head, Accounting Department, U-41A, 368 Fairfield Road, The University of Connecticut, Storrs, CT 06268; telephone (203) 484-3019. We are an Affirmative Action/Equal Opportunity Employer, m/f. (Search #7A426).

#443 LEHIGH UNIVERSITY invites applicants for a tenure-track position in Accounting at the Assistant or possibly Associate Professor level. Candidates must have a Ph.D., DBA, or be near completion; and have teaching/research interests in Information Systems or Managerial Accounting. Appointment can be made in August 1988 or January 1989. The Department seeks a balance between teaching performance and research productivity. Salaries are competitive and employee benefits are excellent. Applications must be sent by November 15, 1987, to: Stuart K. Webster, Chairman, Department of Accounting, Lehigh University, Drown Hall 35, Bethlehem, PA 18015. Lehigh is an EEO/AA employer.

#444 CATHOLIC UNIVERSITY OF AMERICA. Two openings, assistant professors to teach three courses per semester, graduate and undergraduate levels in accounting. Ph.D. preferred but will consider candidates in process of obtaining degree and accompanied by CPA and CMA. The Catholic University of America is sponsored by the Roman Catholic bishops of the U.S. as a national university and center of instruction and research. Its faculties are expected to respect the religious commitment and mission of the University and be supportive of its aims and ideals. Available: 1/1/88, 9/1/88. Contact: Alexander Woroniak, Chairman, Box 254, Catholic University of America, Washington, D.C. 20064.

#445 LA SALLE UNIVERSITY seeks applications for two tenure-track positions at the Assistant/Associate level. Ph.D. in accounting. ABD near completion also considered. Nine hour teaching load (two preparations) in MBA and undergraduate programs. We seek persons with balanced commitment to excellence in both teaching and research. Strong institutional support for both. Information environment where your involvement is sought. Accounting Department has 600 majors and 13 full-time faculty. La Salle is a 125-year-old private institution with 6,500 students. Send resumé to: Joseph Markmann, Chairman, Accounting Department, La Salle University, Philadelphia, PA 19141. Equal/Opportunity/Affirmative Action Employer.

#446 CLARK UNIVERSITY, Graduate School of Management, invites applications for tenure-track faculty position in ACCOUNTING, starting September 1988. Ph.D./D.B.A. preferred; ABD or MBA/CPA considered. Rank, salary, and benefits: competitive and dependent upon qualifications. Teaching load: five sections per year. Publication and professional activities are expected. Clark is a small, quality, private university in Worcester, New England's second largest city (42 miles west of Boston). Application deadline: February 15, 1988. Contact: Dr. Richard J. Bartkowski, Assistant Professor of Accounting, Graduate School of Management, Clark University, 950 Main Street, Worcester, MA 01610.

#447 THE UNIVERSITY OF DELAWARE, Department of Accounting, is recruiting faculty for September 1988. Emphasis in managerial/cost accounting preferred, but other qualified faculty with interest in other accounting areas will also be considered. A Ph.D. or DBA in Accounting is required. The nine hour normal load generally consists of three sections with two preparations. The teaching assignments are selected according to the individual's interests and qualifications. The Department offers an M.S. in Accounting (fifth year), in addition to a strong undergraduate accounting program. Teaching and course development will be expected at both the graduate and undergraduate levels. Undergraduate program accredited by AACSB. The University of Delaware is located in a suburban/rural setting about midway between New York City and Washington, DC. The University of Delaware is an equal opportunity employer which encourages applications from minority groups and women. Please contact: Chairperson, Department of Accounting, College of Business & Economics, UNIVERSITY OF DELAWARE, Newark, DE 19716 (302-451-2961).

#448 GRAND VALLEY STATE COLLEGE. The Accounting Department of the Seidman School of Business is accepting applications from candidates to teach at undergraduate and graduate level. Competitive salary, excellent fringe benefits, summer teaching. Degree requirements are doctorate for rank of Associate or Full Professor; MBA or CPA or CMA are minimum qualifications for rank of Assistant Professor. Other requirements are some teaching experience; research and publication interests. Available after September 1988. Apply to Dr. Donald J. Klein, Department of Accounting, 244 LHH, Grand Valley State College, Allendale, MI 49401. Grand Valley is an Equal Opportunity Affirmative Action Employer.

#449 THE UNIVERSITY OF MINNESOTA'S DEPARTMENT OF ACCOUNTING invites applications for the position of Assistant Professor of Accounting (other ranks subject to qualifications and department needs). Applicants should possess a Ph.D. or should expect to obtain a Ph.D. before beginning employment. Responsibilities include conducting research, advising Ph.D. students, and teaching. A visiting position will be considered. Two applicant pools will be formed. Applications should be received prior to February 15, 1988 for permanent positions and prior to May 15, 1988 for visiting positions. The University of Minnesota is an equal opportunity educator and employer and specifically invites and encourages applications from women and minorities. David A. Dittman, Professor and Chairman, Department of Accounting, University of Minnesota, 271 19th Avenue South, Minneapolis, MN 55455. (612) 624-6506.

#450 FRANKLIN AND MARSHALL COLLEGE invites applications for a tenure-track accounting position, beginning Fall, 1988, at the assistant professor or instructor rank, depending on receipt of doctorate degree. Primary focus in area of cost and managerial accounting. Earned doctorate or ABD, teaching and business experience desirable. Balanced emphasis on teaching and research. Franklin and Marshall College is a private residential coeducational liberal arts college located in Lancaster, PA and enrolling 1850 undergraduates. The business administration program is integrated into the liberal arts curriculum. Vitas, including letters of reference and all transcripts should be directed to: Professor Samual Wagner, Chair, Department of Business Administration, Franklin and Marshall College, P.O. Box 3003, Lancaster, PA 17604-3003. EOE.

#451 CALIFORNIA STATE UNIVERSITY, Chico Department of Accounting and Management Science within the College of Business has faculty vacancies for tenure-track positions in the areas of EDP Auditing, Taxation, Financial Accounting and Accounting Information Systems. Candidates must have an accounting Ph.D. or D.B.A. Teaching performance, scholarly productivity, and university service record are essential attributes for appointments at advanced rank. The Department offers graduate and undergraduate accounting degrees and an undergraduate degree in Management Information Systems. The M.B.A. and Business Baccalaureate programs are AACSB-Accredited. CSU, CHICO is located in Northern California, with outstanding summer and winter recreation available. Housing costs in Chico approximate midwestern metropolitan levels. Send resumé to Dr. Wallace R. Leese, Professor and Chair, Department of Accounting and Management Science, California State University, Chico 95929-0011. Review of applications begins February 1, 1988 until a selection is made. California State University, Chico hires only individuals lawfully authorized to work in the United States. California State University, Chico is an Equal Opportunity/Affirmative Action employer.

#452 GEORGIA SOUTHERN COLLEGE is seeking applicants for a tenure-track position in accounting, starting Fall 1988. Rank will be Instructor or Assistant Professor, depending upon qualifications. MS in accounting or MBA with accounting concentration, CPA or CMA, and 3 or more years of professional accounting experience are required. Teaching experience is highly desirable. Responsibilities include teaching principles of accounting, advising, providing service to the institution, interacting with the profession, and providing current relevant experience. Applications must be received by December 1, 1987. Send resumé to: Dr. William Bostwick, Department of Accounting, L.B. 8141, Georgia Southern College, Statesboro, GA 30460. GSC is an Affirmative Action/Equal Opportunity Employer.

#453 DEPARTMENTAL CHAIR: WRIGHT STATE UNIVERSITY (AACSB Accredited College) is seeking a chair for the Department of Accountancy starting July 1988. Candidate must have Doctorate and be qualified for appointment as a Full Professor. The chair provides leadership to 12 full-time faculty and should have a proven record of excellence in teaching, research and science. The candidate must be willing and able to maintain a strong relationship with the professional certification. The College offers a BS with an Accounting Major and an MBA with an Accounting Concentration. Salary is competitive and is dependent on credentials and experience. Candidates should send a resumé to Accounting Chairperson Search Committee, Attention: Dr. John Hafer, College of Business and Administration, Wright State University, Dayton, OH 45435. Review of applicants is in process and will continue until position is filled. Wright State University is an affirmative action, equal opportunity employer.

#454 UNIVERSITY OF MARYLAND (COLLEGE PARK) invites applications for Assistant or Associate Professor of Accounting. The minimum qualifications for Assistant Professor is a Ph.D. degree. A candidate for Associate Professor should have a distinguished publication record and a record of quality teaching. The University of Maryland is an equal opportunity/affirmative action employer. Women and minorities are encouraged to apply. Interested candidates should send resumés to Professor Martin Loeb, College of Business and Management, University of Maryland, College Park, MD 20742.

#455 GONZAGA UNIVERSITY, Spokane, Washington, seeks applicants for two tenure-track accounting faculty positions—financial/public accounting and tax. Candidates should hold a doctorate in accounting or ABD nearing completion. Professional certification and related work experience are pluses. The School of Business Administration desires well-balanced performance by its faculty, including teaching excellence, publications and service. Gonzaga is a Jesuit university with an enrollment of 3700. School of Business enrollment is approximately 600 undergraduate and 100 MBA students. Spokane is an all-American city of 300,000 within an hour's drive of 70 lakes, 3 ski resorts, and several national parks. Apply to: Dr. Lawrence Lewis, Chairman, Department of Accounting, School of Business Administration, Gonzaga University, Spokane, WA 99258. Gonzaga is an Equal Opportunity Employer.

#456 THE UNIVERSITY OF WISCONSIN-MILWAUKEE is seeking a tenure-track Assistant Professor of Accounting for Fall 1988. All areas considered with particular needs in financial accounting. PhD must be completed. Summer teaching and research opportunities. Salary is competitive. Letter of application and resumé to Dr. Paul M. Fischer, School of Business Administration, University of Wisconsin-Milwaukee, P.O. Box 742, Milwaukee, WI 53201. UWM is an Affirmative Action/Equal Opportunity Employer and is seeking applications from all qualified applicants, especially minorities and women.

#457 PURDUE UNIVERSITY. Applicants are invited for positions in accounting at both the junior and senior levels for appointments beginning in August 1988 or January 1989. A Ph.D. or D.B.A. degree is required. Candidates for appointment as assistant professor must exhibit capacity for quality research and teaching. Candidates for appointment as associate or full professor must have a record demonstrating excellence in research and teaching. Resumés should be sent, before

March 15, 1988, to Professor Robert Eskew, School of Management, Purdue University, West Lafayette, Indiana 47907. Telephone 317-494-4469. Purdue University is an Affirmative Action, Equal Opportunity Employer.

#458 CHAIRPERSON—Accounting Department, College of Commerce and Industry, University of Wyoming, Laramie, Wyoming. Candidates must provide leadership in academic and research programs and interact with the business and professional community. Rank and salary open and competitive; outstanding fringe benefits. Candidates should be tenurable and possess a doctoral degree in accounting. Send resumés to: Donald F. Parker, Dean; College of Commerce and Industry; University of Wyoming; Laramie, Wyoming 82071. University of Wyoming is an Equal Opportunity, Affirmative Action Employer. Deadline for applications, January 31, 1988.

#459 ARIZONA STATE UNIVERSITY is seeking applicants for tenure-track position at Assistant rank. Applicants should have an earned doctorate and specialization in accounting or in final stages of dissertation with an emphasis in information systems or financial accounting. Send a vita to: Ralph E. Smith, Chair, Faculty Recruiting Committee, School of Accountancy, College of Business, Arizona State University, Tempe, AZ 85287. Arizona State University is an Equal Employment Opportunity/Affirmative Action Employer.

#460 NORTH CAROLINA STATE UNIVERSITY invites applications for a tenure-track position in accounting beginning in the fall of 1988. An earned doctorate is required, although advanced ABDs will also be considered at the Assistant Professor level. Important qualifications include demonstrated interest in and ability to do publishable research, and a commitment to teaching excellence. Preference will be given to candidates specializing in auditing or accounting systems. Please send resumé to Joanne Rockness, Accounting Search Committee, Department of Economics and Business, North Carolina State University, Box 8110, Raleigh, North Carolina 27695-8110. North Carolina State University is an affirmative action/equal opportunity employer.

#461 THE STATE UNIVERSITY OF NEW YORK AT BUFFALO has a September 1988 opening for an Assistant or Associate Professor of Accounting. Fields of interest may include financial accounting, managerial accounting, auditing, taxation, or accounting information systems, with teaching opportunities at undergraduate, M.B.A., and Ph.D. levels. Teaching load is six hours per semester. Candidates for an Assistant Professor position should have a strong interest in research and possess relevant research tools and have an earned doctorate or be in the advanced stage of dissertation research by September 1988. Candidates for an Associate Professor position should have a completed doctorate, an established research record, demonstrated teaching ability, and an ability to supervise doctoral students and work with junior faculty. Salary and fringe benefits are competitive. The University is an Affirmative Action/Equal Opportunity Employer. Please send resumé to Professor John C. Gardner, 344 Jacobs Management Center, State University of New York at Buffalo, Buffalo, New York 14260.

#462 THE UNIVERSITY OF SOUTH FLORIDA is seeking highly qualified faculty members to teach graduate-level courses in accounting. These positions are at the assistant professor, associate professor and professor rank. Those considering the position must have a demonstrated interest in, and leadership capacity to do, publishable research and a high level of competence in teaching graduate-level courses in the Master of Accountancy and Ph.D. programs. Those individuals must have experience in the supervision of doctoral dissertations. The University of South Florida is an affirmative action/equal opportunity employer. Please send vita to Robert J. West, Director, School of Accountancy, College of Business Administration, University of South Florida, Tampa, FL 33620.

#463 POSITION WANTED: Recently graduated DBA Accounting. Has some years of teaching experience. Seeks a tenure-track position.

#464 DEPAUL UNIVERSITY'S SCHOOL OF ACCOUNTANCY invites applications from highly qualified candidates for tenure-track positions in Financial Accounting, Auditing, and MIS. Rank and salary commensurate with qualifications and experience. Doctorate preferred for all positions; ABD within one year of completion will be considered. Evidence of consistent teaching excellence and scholarly capabilities and accomplishments are essential. Research support is extensive. The School is fully accredited by the AACSB, is an FSA charter member, and offers 3 undergraduate and 5 graduate programs to 1500 accounting students. Located in Chicago's commercial district, DePaul offers significant research and professional opportunities. Please contact Dr. John T. Ahern, Jr., Director, School of Accountancy, DePaul University, 25 E. Jackson Blvd., Chicago, IL 60604. DePaul is an EEO employer.

#465 SOUTHERN ILLINOIS at Edwardsville (suburban St. Louis, MO) seeks candidates for two positions in Accounting. Specialty areas are Cost/Managerial and Auditing/Systems. Rank open. Salary is competitive and dependent upon qualifications. Candidates should possess a PhD or DBA. ABDs nearing completion will be considered for Assistant Professor position. Professional certification desirable. The School of Business is accredited by AACSB at the undergraduate and graduate levels and the Accounting program is accredited at the undergraduate level (Type A). The Department has a balanced commitment to teaching, research, and service. Application deadline is January 1, 1988, or until position is filled. Applications should be sent to: Dr. M. Robert Carver, Jr., Chairman, Department of Accounting, Box 1104, Southern Illinois University at Edwardsville, Edwardsville, Illinois 62026. An affirmative action equal opportunity employer.

#466 BOWLING GREEN STATE UNIVERSITY is seeking applicants for tenure-track positions (associate or assistant) and term instructors in accounting or management information systems, starting August 1988 or January 1989. Requirements for the tenure-track positions are a Ph.D. or equivalent (or an advanced-stage ABD at the assistant level) and a commitment to research and teaching. Applicants for instructor should hold an appropriate master's degree. The CPA, CMA, or CIA certificate is desirable for accounting applicants. The University, a state-supported institution with an enrollment of 16,000 is located 25 miles south of Toledo. Applications and inquiries should be directed to Professor Thomas G. Evans, Chair, Department of Accounting and Management Information Systems, Bowling Green State University, Bowling Green, OH 43403. Bowling Green is an Equal Opportunity/Affirmative Action Employer.

#467 VISITING POSITION WANTED. Ph.D. CPA, LLB. Seventeen years teaching experience. Publications, including Accounting Review. Desires visiting position at college or university in major city for 1988–89 academic year.

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#469 THE UNIVERSITY OF MICHIGAN-DEARBORN, School of Management, invites applications for Accounting Positions, available September 1988. Rank through Associate Professor available to candidates possessing a Ph.D./DBA with CPA/CMA preferred; ABD's considered. The successful applicant will be dedicated to quality teaching, research and service activities. Department leadership potential for interested candidates. Apply to Gail McCracken, Assistant Dean, School of Management, The University of Michigan-Dearborn, Dearborn, Michigan 481-280-1491. Posting remains open until positions are filled. The University of Michigan—Dearborn is an equal opportunity educator and employer and specifically encourages women and minority applicants.

#470 CHAIRPERSON, TENNESSEE TECHNOLOGICAL UNIVERSITY seeks a senior scholar for Chairperson of the Department of Accounting and Finance, a unit of the College of Business Administration. The Department, a multidisciplinary group of fifteen faculty, serves 700 undergraduate majors and offers a full range of accounting and finance courses, and basic law courses, at the B.S. and M.B.A. levels. All programs in the College, including the accounting major, are AACSB-accredited. The College, including the accounting major, are AACSB-accredited. The Chairperson provides academic leadership and fosters departmental collaboration with other units of the College and University, the accounting profession, and the business community. The position requires strong leadership qualities and good interpersonal skills. Administrative experience not required, but highly desirable. Candidates must have doctorate and record of scholarly achievement commensurate with at least the rank of Associate Professor. Rank depends on qualifications, and salary is competitive. Anticipated starting date Fall 1988, but earlier date desirable. Send resumé to Dean Fred E. Williams, College of Business Administration, Box 5025 Tennessee Tech, Cookeville, TN 38505. Applications accepted until position is filled. TTU IS AN AFFIRMATIVE ACTION/EQUAL OPPORTUNITY EMPLOYER.

#471 TENNESSEE TECHNOLOGICAL UNIVERSITY invites applications for a tenure-track position beginning Fall 1988. All levels invited to apply. Doctorate and appropriate level of scholarly achievement required for senior level, but promising ABDs considered at entry level. Professional certification a plus. Salary competitive with AACSB-accredited public universities. Position open until filled. Contact: Dr. Don R. Cook, Interim Chairperson, Department of Accounting and Finance, College of Business Administration, P.O. Box 5024, Tennessee Tech University, Cookeville, TN 38505. TTU IS AN AFFIRMATIVE ACTION/EQUAL OPPORTUNITY EMPLOYER.

#472 SOUTHEAST MISSOURI STATE UNIVERSITY is seeking qualified faculty in Accounting. Qualifications: a doctorate in Accounting, classroom excellence, professional growth potential, and ability to relate to students, faculty, and business community. Compensation is competitive. The Department has an especially strong program with approximately 750 majors. Cape Girardeau is a "Best Town in America" with a population of 35,000. Review of applicants begins October 1, 1987; open until filled. Send vita to Dr. Keith A. Russell, Chairperson, Department of Accounting & Finance, Southeast Missouri State University, Cape Girardeau, MO 63701. The University is an equal opportunity/affirmative action employer.

#473 ALL POSITIONS, tenure-track, for the 1987–88 year. Minimum qualifications: Ph.D. or DBA in Accounting (ABD considered if dissertation in process). Undergraduate and graduate level teaching. Salary is competitive. Send resumé to: Teddy L. Coe, Department of Accounting, North Texas State University, Denton, Texas 76203. NTSU is an Equal Opportunity, Affirmative Action Employer.

#474 CHAIRPERSON, Department of Accounting, University of Nevada, Las Vegas. There are 14 faculty, 600 undergraduate majors; MS and MBA Programs. Applicants must have an earned doctorate in accounting from an AACSB accredited school and a record of recent and continuing research appearing in national publications. Send resumé, letter of application and three letters of reference to: Chair, Chairperson Search Committee, Department of Accounting College of Business and Economics, University of Nevada, Las Vegas, Las Vegas, Nevada 89154. Review of applications will begin on January 1, 1987 and continue until the position is filled. EO/AA employer.

#475 LECTURER, ASSISTANT OR ASSOCIATE PROFESSOR; auditing is our primary need, but others will be considered. Assistant and Associate positions require a doctorate in accounting from an AACSB accredited school; Associate requires a record of teaching excellence and a record of recent and continuing research published in national refereed journals. ABD within one year of completion will be considered. Masters/CPA can be appointed to non-tenure track lecturer positions. Send resumé to: Chair, Department of Accounting, College of Business and Economics, University of Nevada, Las Vegas, Las Vegas, Nevada 89154. Review of applications will begin on January 1, 1987. EO/AA employer.

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CONTACT FOR FURTHER INFORMATION

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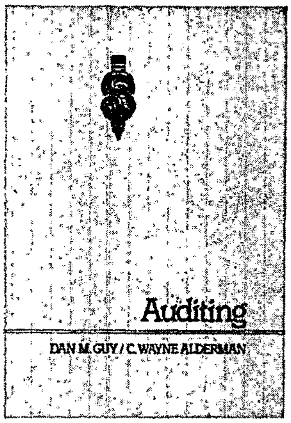

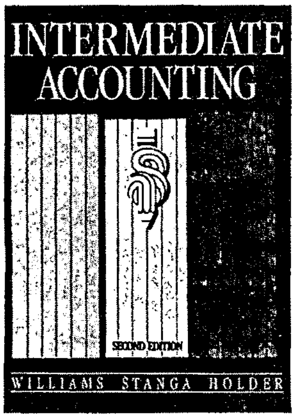

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Contact: Dr. Harold E. Wyman, Department Head, Accounting Department, Box U-41A, 368 Fairfield Road, The University of Connecticut, Storrs, CT 06268, Telephone (203) 486-3019. We are an Affirmative Action/Equal Opportunity Employer, m/f. (Search #7A427)

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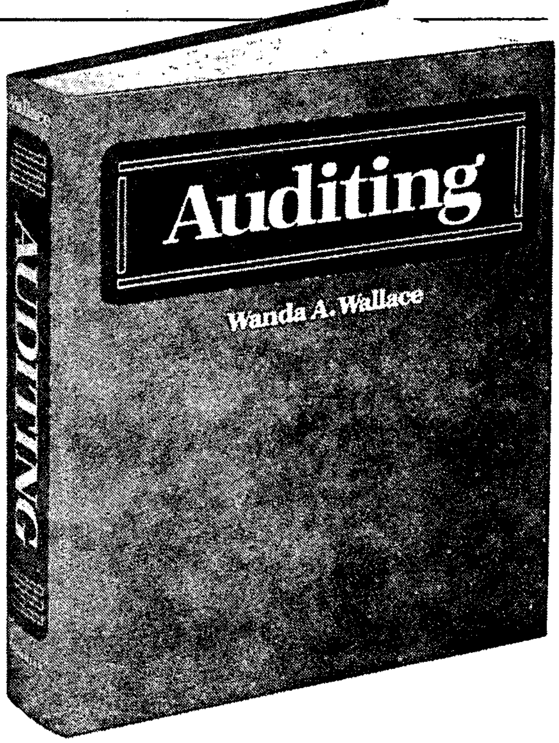

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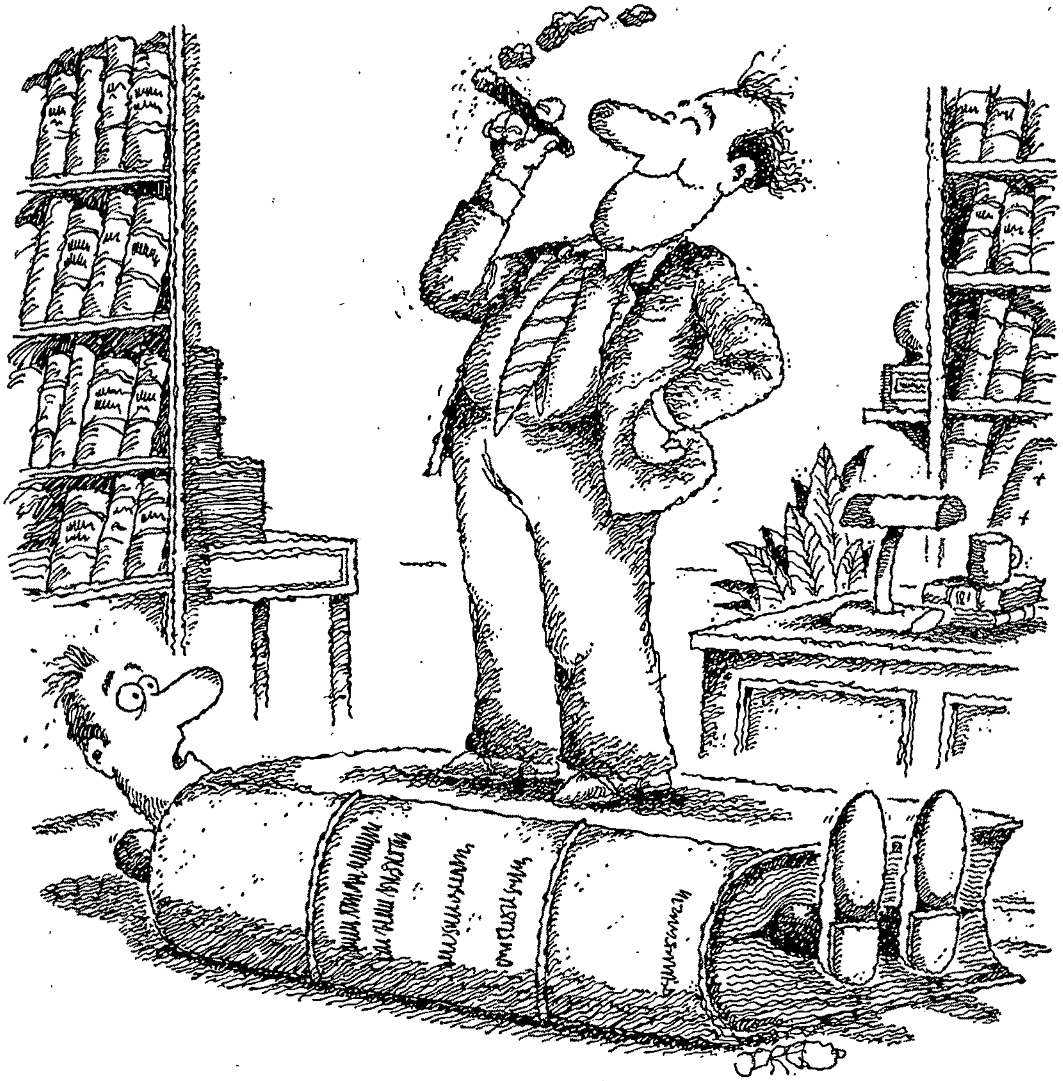

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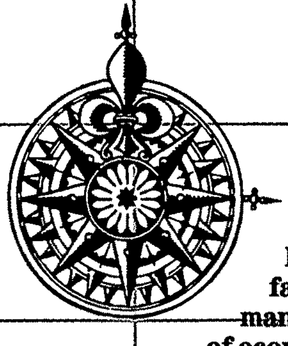

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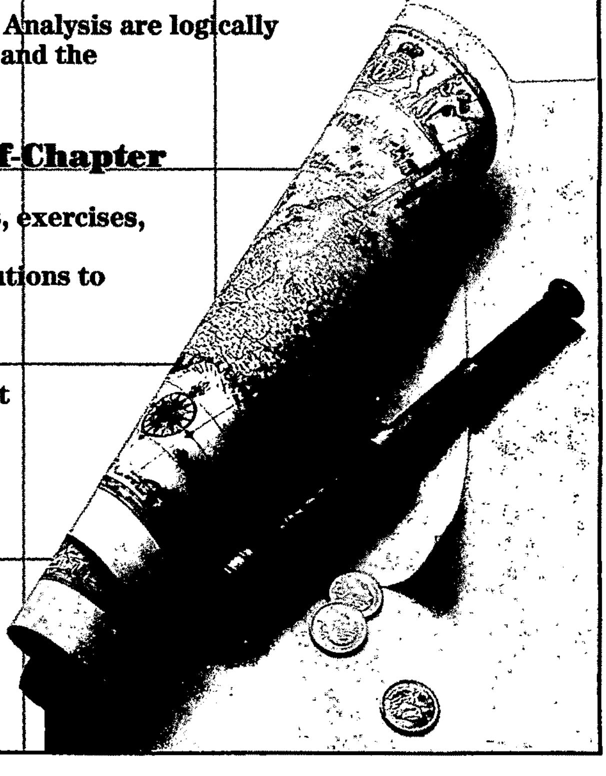

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